The Philippine Agriculturist and Forester

- 8 AUG 1949
Ag. 25

Vol. II 1912 No. 1-3

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THE PHILIPPINE AGRICULTURIST AND FORESTER

VOLUME II

1912

Published by
The College of Agriculture, University of the Philippines
Los Baños, Laguna, P. I.

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THE PHILIPPINE AGRICULTURIST AND FORESTER

VOL. II. 1912 Nos. 1-3

AGRICULTURE AT THE PHILIPPINE EXPOSITION

The first Philippine Exposition opened in Manila, February 3rd, and was expected to close February 10th. The Carnival was held on adjoining grounds during the same time. Rainy weather interfered with the program on two days so seriously that the date of closing was postponed to February 12, and the same change was made in the exposition date.

For exhibition during these eight or ten days, there was brought altogether the greatest, most interesting, and most valuable collection of the products of the Philippines which has ever been assembled. The exhibits made in connection with previous carnivals were dwarfed by comparison, leaving the exposition of 1895, and that made at the World's Fair at St. Louis in 1904, as in any way approaching that of this year. Both of these were kept open for several months. The former was held in Manila on the grounds and in the buildings now occupied by the Normal School. It was a great show, for which extensive preparations were made, and concerning which there were full and valuable publications in the official press of that time. But a study of these publications forces the conclusion that it was far from being as great a display of the products of the islands as the one just closed. The most unfortunate feature of the latter has been its short duration, which made the thorough study which the exposition deserved altogether impossible. The Philippine exhibit at St. Louis was extensive and expensive and attracted great interest, but the features which received most attention were those which appealed to a throng of idle curiosity-seekers, rather than those which would tell the story of a people's wealth and industry. The wild people of the islands had a place in this exposition also, but this place was more nearly commensurate with the insignificant one these people occupy in Philippine life.

In the exhibits of the Insular Government, the Bureau of Agriculture, which at carnivals in the past has occupied as small a place as possible, came into its own this year and received first prize. The agriculture and horticulture building was given over in very large part to the exhibit of this bureau. The new Director of Agriculture is a gentleman with wide experience in expositions and his ripe judgment and the industry of his assistant, Mr. Edwards, were combined for the production of a display which for the first time was in some measure representative of the agricultural wealth of the islands, and also exceedingly well presented. Down the center of the hall were kiosks, each one being a display of one of the great staple crops: abacá, sugar, rice, maize, tobacco, and coconuts. The center of the building was occupied by a fountain filled with lotus flowers. Where space was available in the aisles and corners, there were displays by some of the leading Manila florists.

About the walls were booths each devoted to the display of some crop or phase of agricultural activities. In one of these, which served as a local office, were maps and charts which indicate that remarkable progress has been made in the suppression of rinderpest in the few months during which a vigorous quarantine campaign has

been carried on in place of the previous treatment with serum. The collection of forage crops which occupied one booth had been assembled under the direction of Colonel Gresham of the United States Army. A particular effort has been made during the past year to develop in the Philippines enough business of this kind so that the army should not be driven to importation to keep up its supply, and this exhibit gave very strong promise of success. Other booths were given over to fruits, garden truck, miscellaneous fibers, demonstration of methods in plant propagation, warfare against diseases and pests, etc.

The exhibit of the College of Agriculture occupied one of these booths. As a back ground, silk was used above the shelf level, and sugar cane below it, solid screens being made from both. From the large number of articles being produced by the College, choice was made of those most likely to be instructive and interesting to the public. Among these were roselle, exhibited for the first time in the Philippines, and jelly and jam made from it; starch from different sources; a variety of yams, sweet potatoes, different kinds of maniok, and other root crops; peculiar varieties of banana; various fibers, including coir, bow-string hemp, and particularly fine pineapple and banana fibers; and a large assortment of native legumes.

Among the provincial displays, Pampanga received first prize for its agricultural exhibit. Proximity to Manila made it possible for this province to combine with its staple crops a quantity of fruit and fresh vegetables, the most of which will not keep in presentable condition long enough to be brought from more remote provinces. Moreover, the Pampanga exhibit was conspicuously well displayed. The different articles were shown in boxes of uniform size, each large enough to satisfy the eye, the whole giving a harmonious effect better than that attained by any other province except Samar. Occidental Negros brought a greater variety of agricultural produce and a much better exhibit of certain crops, especially sugar, than did Pampanga, but its display was crowded, without uniformity, and contained with the good material other articles of very inferior merit. Cebu, Tayabas, and Samar were other provinces which made conspicuously fine agricultural displays. But practically every province participating had so much and such good material that it is perhaps invidious to single out a few for mention.

The display of agricultural produce had of course a large part in determining the award of general prizes. A silver cup was offered to the province in each of the five classes which made the best general display. These cups were awarded to Iloilo, Laguna, Cavite, Samar, and Mindoro. Pangasinan set a standard which may well be enduring in the artistic presentation of its chief crop. It occupied one of the largest concessions, and the entire wall and ceiling space was covered with rice in the head. In the middle of the ceiling was a dome into which projected from the ground a huge structure in the shape of a rice stack made of the same material.

Turning now to a consideration of the different crops, the exhibit of abacá was the most conspicuously fine and profuse, and was without question the best display of this product which has ever been assembled. The screening and festooning in the agricultural building were practically all done with pure white abacá. The fiber was used in the same way in a number of the provincial buildings; with especially good effect in the Samar building, where the columns were enclosed in abacá pleated in attractive patterns, and in the Laguna exhibit where abacá, as white as the foam itself, was used to make an imitation of the famous Botocan fall. Almost every

province south of Manila exhibited this product, and in every case the material brought was well above any recognized market grade in its quality. In the Albay exhibit was a machine which was in operation every afternoon producing a fairly clean fiber with satisfactory rapidity. Various abaca products were shown including fine sinamay from various localities, and an excellent exhibit of rope from Laguna.

Coconuts were also largely used in decorating provincial buildings. Pangasinan set the example of using whole nuts for this purpose, and was followed to good purpose by Tayabas and other provinces, while still others used split nuts. Several of the provinces brought coir, and a little of this was of good quality. Remarkably large nuts were shown by Bohol and some other provinces, including the Moro Province which used them for decoration. Dwarf nuts, and cups and fancy articles made from them, were shown by Camarines, Capiz, and other provinces. In the Iloilo exhibit were nuts constricted above the bottom, and from Occidental Negros there came a single cream colored nut more than twice as long as thick. A great deal of copra was on exhibition. Some of this, notably individual exhibits from Oriental Negros, Bohol, Albay, and Cebu, was of excellent quality, but the most of it was not far from the usual Manila market grade which has no proper place in an exposition and ought to have none in commerce.

More or less rice was brought by almost every province. In the provinces from Tarlac and Nueva Ecija north, the most of the rice is bearded, and is accordingly an especially attractive article for decoration. Pangasinan's use of it has already been mentioned. Both palay and hulled rice were exhibited in large quantity and great variety. Presentation of the hulled rice and the unhulled (palay), with the two exhibits of a single variety occupied compartments in one box, and with all the boxes used for this purpose uniform in size and packed solidly together, a method introduced at last year's carnival by Mr. Barclay, then in charge of the Iloilo exhibit, was this year imitated, but not as extensively as it might well have been. Some palay was also shown in small buri bags. Where these are small and well made and perfectly uniform, an attractive display is made, but unless great care is taken, the effect produced by this method of display is untidy and unattractive. A number of provinces, possibly a majority, exhibited numerous varieties, but took no pains to make the different samples uniform, using indiscriminately buri bags of various sizes, some clean and others not so, boxes, and sacks of paper and cloth. In the interest of the general attractiveness of the whole exposition, such disorderly exhibits might well be barred from display in the future. The number of varieties shown by some provinces was very large; Capiz, with more than five hundred varieties distinct at least in name, was first in this respect.

Of the articles brought in large quantity to the exposition, maize made decidedly the worst showing. There was a considerable quantity of maize of really good quality in the Moro exhibit. Aside from this, there were good ears shown by Cebu, and possibly one or two other provinces, but most of the exhibits did not contain a single ear which would not better have been left at home. As there is fairly good corn in many parts of the Philippines, the low quality of that shown at the exposition is hard to understand.

The only rubber shown was that of the Basilan Plantation Company in the Moro Province concession, but this exhibit ought to effectively do away with the doubts of all who have been questioning the pos-

sibility of producing good rubber in large quantity in the Philippines. It was shown here in the various market forms, some of indifferent quality, but much of it clean, clear, strong, elastic, and in every respect first class. A large screen was made of sheet rubber. There was a good sized mound of rolled sheets; and an artistic sign in the door of the building made of twisted rubber. As an educational exhibit, this was the most valuable on the grounds.

Root crops were creditably shown by various provinces, most notably by Samar, Cebu and Bohol. Among these were yams of possibly a dozen kinds, some of them of prodigious size; some excellent sweet potatoes, and some phenomenally large sweet potatoes by Nueva Vizcaya; several varieties of gabi; and some other aroid root crops in the Samar exhibit, of kinds as yet unknown in general cultivation, but which, if the testimony of the exhibitors is valid, should be introduced throughout the islands. Specimens of these were secured for trial by the college.

Fresh fruit and garden truck could be used to good purpose only by the provinces nearest Manila. Cavite, Bulacan, and Pampanga were the only ones which brought it in profusion. In the building of the Bureau of Education, however, was an exhibit of school garden produce which any State Fair in America would do well to rival in quality. The best single exhibit here was that of the Philippines Normal School, but the bureau had arranged for shipment and preservation in cold storage so that excellent displays were placed on the shelves perfectly fresh from as far away as Ilocos Norte. In this connection, mention should be made of the exhibit made by the Tanauan school nursery which occupied nearly a third of the space, and furnished the most instructive part, to judge by the attention it received from visitors, of the entire Batangas exhibit.

In response to the invitation to individual planters to enter articles in competition for individual prizes, there were entries from nearly all of the provinces, and the most of the articles so shown were of excellent quality. The idea being a new one here, the number of competitors for most of the medals was small. But the result of the offer was better than had been anticipated. It was very evident that when another exhibition is held, the competition for these individual prizes will be keen, and that the standard of the entire exhibition will be very materially raised as a direct result of this individual effort. A list of the recipients of the prizes and of those who were given diplomas of honorable mention follows:

AGRICULTURAL-HORTICULTURAL AWARDS AT THE FIRST PHILIPPINE EXPOSITION.

COCONUTS.

Best five seed nuts.

1st.—Catalino Casinas, Bohol.

2nd.—José Nugarin, Cebu.

Hon. Men.—Antonio Miñosa, Cebu.

Most copra from one nut.

1st.—M. Literal, Oriental Negros.

2nd.—Catalino Casinas, Bohol.

Hon. Men.—E. S. Gotaner, Nueva Ecija.

Best picul of copra.

1st.—Catalino Casinas, Bohol.

2nd.—E. Mateas, Albay.

Hon. Men.—P. O. Mirjan, Tayabas.

Copra richest in oil.

1st.—Henry Fleisher, Oriental Negros.

Best sample of oil.

1st.—E. F. Malvar, La Laguna.

2nd.—E. Gotaner, Nueva Ecija.

Best sample of coconut fiber.

1st.—Eladio Sablan, College of Agriculture.

Hon. Men.—Zacarias Albay, Capiz.

ABACA.

Longest fiber.
1st.—Ohta Development Co., Davao.
2nd.—Vicente Sanchez, Mindoro.

Strongest fiber.
1st.—Pardo Barrios, Ambos Camaines.
2nd.—Gerardo Quibo, Oriental Negros.
Hon. Men.—Wilson Plantation Company, Davao.

Finest fiber.
1st.—S. A. Coronel, Cavite.
2nd.—Fausto Anciro, Cavite.
Hon. Men.—Juan Araneta, Occidental Negros.

Best fiber.
1st.—Felipe de Morente, Mindoro.
2nd.—Wilson Plantation Co., Davao.
Hon. Men.—Ohta Development Company, Davao.

Best hat-making fiber.
1st.—Aldamio Sobrino, Mindoro.

MAGUEY.

Best sample of maguey.
1st.—Maximo Alfafara, Cebu.
2nd.—Gregorio Florida, Cebu.
Hon. Men.—Leona Inocelda, Ilocos Sur.

PINEAPPLE FIBER.

Best sample of pineapple fiber.
1st.—Florencio Bagui, College of Agriculture.

TOBACCO.

Best wrapper leaf.
1st.—Julian Sanson, Isabela.
2nd.—Mrs. Venancia Pereira, Isabela.

Best plug tobacco leaf.
1st.—Felix Paggao, Isabela.
2nd.—Joaquin Ortega, Ilocos Sur.

Best cured tobacco.
1st.—Mrs. Venancia Pereira, Isabela.
2nd.—Angel Garces, Cagayan.

Largest sound tobacco leaves.
1st.—Ruperto Amadora, Cebu.
2nd.—Pedro Sanson, Isabela.

SUGAR.

Best exhibit of five stalks.
1st.—Hacienda Tinang, Tarlac.
2nd.—Sebastian Visitación, Or. Negros.

Heaviest cane.
1st.—Juan Araneta, Occidental Negros.
2nd.—Vicente Sanchez, Mindoro.

Best purple cane.
1st.—Florencio Noel, Cebu.
2nd.—Demetrio Lorena, Oriental Negros.

Best green or yellow cane.
1st.—Pantaleon Galura, Nueva Ecija.
2nd.—Luis Ferrer, Cavite.

Best assortment of varieties.
1st.—Maximino Jalandoni, Iloilo.
2nd.—Julia Paras, Pampanga.

Best sugar ready for market, in containers.
1st.—Ynchausti & Co., Iloilo.
2nd.—Alejandro Policarpo, Nueva Ecija.
Hon. Men.—Viuda de Tagle, Oriental Negros.

Best panocha.
1st.—Tomas Delmundo, La Union.
2nd.—Bonifacio Ermitaño, Cavite.

COFFEE.

Best sample.
1st.—Pedro Gaco, Cebu.
2nd.—Segunda Alisangco, Ilocos Sur.
Hon. Men.—Sr. Yap, Cebu.

CACAO.

Best sample.
1st.—Bartolome Bañares, Albay.
2nd.—Segunda Alisangco, Ilocos Sur.
Hon. Men.—Paulino Dianco, Capiz.

RUBBER.

Best exhibit.
1st.—Basilan Plantation Company, Moro.

RICE.

Best paddy rice.
1st.—C. R. Manuel, Nueva Ecija.
2nd.—José Sociapco, Tarlac.

Best upland rice.
1st.—Mandao, Bukidnon.
2nd.—Dulian, Ifugao.

Best glutinous rice.
1st.—Arcadio Recometa, Nueva Ecija.
2nd.—Augustino Alvarez, Capiz.
Best pinipig.
1st.—A. de Alvarez, Capiz.
Heaviest five heads of grain, in head.
1st.—E. L. Worcester, Nueva Ecija.
2nd.—Vicente Melencio, Nueva Ecija.

CORN.

Best exhibit of five ears.
1st.—J. Spirig, Moro Province.
2nd.—Florencio Noel, Cebu.
Hon. Men.—Antonio Gonzaga, Occidental Negros.
Heaviest liter of shelled corn.
1st.—J. Spirig, Moro Province.
2nd.—Antonio Gonzaga, Occ. Negros.

MILLET.

Best exhibit of ten heads.
1st.—Pedro Rances, Bohol.
2nd.—Faustino Salvador, Cebu.

SESAMUM.

Best liter of seed.
1st.—Honorio Lasan, Cagayan.
2nd.—José Sociapco, Tarlac.
Hon. Men.—José Barrios, Capiz.

CORN-BLADE FODDER.

Best sample.
1st.—Chas. Shück, Jolo.
2nd.—Pablo Tan, Leyte.
Hon. Men.—Florencio Noel, Cebu.

DRY FORAGE.

Best sample:
1st.—Albert F. Keil, Moro Province.
2nd.—Leandro Reyes, La Laguna.
Hon. Men.—R. T. West, Moro Province.

GREEN FORAGE.

Best sample.
1st.—M. Magno, Rizal.

TAPIOCA STARCH.

Best sample.
1st.—B. M. Gonzalez, College of Agriculture.
2nd.—Vicente Bartolomé, College of Agriculture.

ARROWROOT STARCH.

Best sample.
1st.—Daniel Dado, Capiz.
2nd.—Pablo Ligones, Bohol.
Hon. Men.—Juan Lomuntad, Samar.

TACCA STARCH.

Best sample.
1st.—Amando Laparan, College of Agriculture.

SWEET POTATOES.

Best exhibit.
1st.—Eugenio Villanos, Tarlac.
2nd.—Miguel Cordova, Capiz.
Hon. Men.—Severino Claren, Bohol.
Hon. Men.—Chas. Shauger, Samar.

YAMS.

Best exhibit.
1st.—Felipe Sespon, Bohol.
2nd.—Ruperto Sarmiento, Cebu.
Hon. Men.—José Bugarin, Cebu.

GARDEN TRUCK.

Best Tomatoes.
1st.—Frederick Fisher, Pampanga.
2nd.—Enrique M. Baretto, Rizal.
Best potatoes.
1st.—Wenceslao Vabra, Nueva Vizcaya.
2nd.—Pantaleon Bacomo, College of Agriculture.
Best Chili.
1st.—Pantaleon Bacomo, College of Agriculture.
Best Squashes and Gourds.
1st.—Inocencio M. Delgado, Bulacan.
2nd.—Vicente Rivera, La Union.

Best Cincamas.
1st.—Pelagia Serrano, Tarlac.
2nd.—Rafael Sarmiento, La Union.
Hon. Men.—Inocencio M. Delgado, Bulacan.
Best cabbage.
1st.—Ceferino Joven, Pampanga.

FRUITS.

Best Bananas.
1st.—Buenaventura Dimaguila, La Laguna.
2nd.—Inocencio Delgado, Bulacan.
Best citrus fruits.
1st.—Nicolas Alba, Capiz.
2nd.—Felix Cuenca, Cavite.
Best Mangos.
1st.—G. Medina, Cavite.
Best general collection of fruits.
1st.—Lais Trading & Development Co., Davao.

NURSERY EXHIBIT.

Best Nursery exhibit.
1st.—Tanauan Intermediate School.

ORNAMENTAL PLANTS.

Best general exhibit.
1st.—Luzon Floral Co., Manila.
2nd.—Regino Fermin, Manila.
Hon. Men.—Wm. S. Lyon. Manila.

PEANUTS.

Best exhibit.
Hon. Men.—Macario Gantuanco, Cebu.

KAPOK.

Best exhibit.
Hon. Men.—Henry Fleisher, Oriental Negros.

CASTOR BEANS.

Best exhibit.
Hon. Men.—Gelacio Tabiana, Iloilo.

GINGER.

Best exhibit.
Hon. Men. Josefa de Guzman, Bulacan.

GABI.

Best exhibit.
Hon. Men.—Solano Anceta, Samar.

MUNGO.

Best exhibit.
Hon. Men.—Agapito Tating, Antique.

A Glimpse Into the Chemistry of Human Nutrition

By Horace G. Deming, *Associate Professor of Chemistry.*

Perhaps no scientific matter receives such unscientific treatment as does the subject of human food. Some people become violent advocates of a vegetable diet, a nut diet, or a milk diet; others consume enormous quantities of sirloin steak, thinking to develop muscular power, or try to cure bodily ailments of all kinds by fasting for extended periods. Thousands buy patent breakfast foods, whose promoters give out the impression that such a diet helps to develop brain in the brainless; others strive to become centenarians by flooding their systems with butter milk.

Even those persons who know something of the chemical nature of human food take much for granted that is yet unproven. Such people think that they can estimate the value of beans as muscle-builders by boiling them with sulphuric acid, or that they can calculate the power of lard to warm our bodies by burning it in a calorimeter. No wonder that the majority of mankind ridicule the food-faddists and ignore what are called scientific conclusions, and cheerfuly eat what they feel like taking of all that is brought to table.

However, in spite of the faulty conclusions and unwarranted generalisations of many popular books on the subject, the real science of human food is making rapid progress. Let us here recall some of the well-known principles of the chemistry of foods, in order that we may better appreciate the relation of the old knowledge to the new. A few of the most recent

scientific papers are listed at the end of this article; a good popular text is Olsen's "Pure Foods" (Ginn & Co., 1911); a good book for the general reader, if he has some knowledge of organic chemistry, is Chittenden's "The Nutrition of Man" (Stokes, 1907).

The bulk of our food falls into the three classes of fats, carbohydrates, and proteids. Of these the fats are preeminently the bodily fuels, being able to yield about 2¼ times as much heat when assimilated as either carbohydrates or proteids. Nevertheless the fats and oils of vegetables are generally less digestible than those of animals, and differences among individual fats are so great that no one should consider a high fat content as an indication of great fuel value, unless the analysis is supported by other evidence. Experiments with man and the lower animals show that a mixture of fats is tolerated by the digestive tract in larger quantities and with a better assimilation than is any single substance of this kind. Studies are being made on the part played by different fats in nutrition, with a view to settling such debated questions as to whether oleomargarine is as nutritious as butter. [1]

Fats and carbohydrates both contain carbon, hydrogen, and oxygen, but carbohydrates are relatively richer in oxygen, and possess less fuel value. To this class of substances belong the sugars, of which perhaps a dozen occur in foods, but the chemist knows many others as yet to be found only in the laboratory. Starches are a group of carbohydrates for the most part insoluble in water, yet readily digestible, since they may be easily changed into glucose (grape sugar). Inulins are like starches in some respects, but are converted into fructose (fruit sugar) when digested; they have lately been discovered in many monocotyledonous plants, and may constitute a more common source of food than is generally supposed. Dextrins are formed from starches when the latter are heated, and are accordingly found in the crust of bread. Pentosans and celluloses are a group of carbohydrates whose value as human food is supposed to be small, though they are partly digestible by herbivorous animals; they make up the fibrous part of vegetable foods.

Proteids are the substances which serve for the repair of tissue and the construction of muscle and nerve during growth. The white of an egg is an example of the class of proteids known as albumens, which contain all three of the elements that enter into the composition of the fats and carbohydrates, but sulphur and nitrogen in addition. The nucleo-proteids, or vitellins, contain the five elements common to all proteids, but are characterised by the additional occurrence of phosphorus. They are the typical proteids of the yolk of egg, and of the common grains and legumes; very similar is casein, the chief proteid of milk.

Lipoids are a class of fat-like substances, which contain phosphorus and nitrogen in addition to the elements composing true fats. They form a very important part of plant and animal tissues, but the office they perform there and their value in nutrition are but little known. Recent studies show that mice will die if fed upon food from which lipoids have been removed, [2] and the inference is that this class of compounds will be found to play a necessary part in human nutrition.

Phytin is an organic compound of phosphorus which is now [3] known to occur in many cereals combined with calcium or magnesium. In the wheat it occurs chiefly in the outer layers, and the advantages of a diet of whole wheat over one of white bread may be in part due to the fact that the former contains these organic compounds of phosphorus and calcium.

Inorganic salts of calcium, magnesium, sodium and iron play an important rôle in nutrition, partly in supplying special elements to different parts of the body, partly in regulating the secretion of various fluids in the progress of digestion. The inorganic compounds contained in the cells of the body are essential to their life, the bones are composed largely of calcium and phosphorus, the blood contains iron, and the thyroid gland a compound of iodine. All of these elements are supposed to be furnished by the inorganic salts in the food, for some evidence has been lately produced [4] showing that even phosphorus does not necessarily come from the nucleo-proteids of the food. We trust to chance to supply these elements in our diet, but cases probably exist where one or more of them is present in insufficient amount or in improper form, such an occurrence being one of the supposed causes of beri-beri. Much research must still be done in this important part of the chemistry of foods.

The substances which produce the pleasant odor of fruits are known as esters. The amount of these in foods is inconsiderable, yet they play an important part in digestion, for the pleasurable sensation produced by their presence stimulates the flow of saliva and gastric juice, and so aids digestion. Condiments of all sorts are not to be despised, for any influence tending to make eating pleasurable is as important as the correct chemical composition of the food. Many experiments on the feeding of animals and men have probably given false results, poor digestion and assimilation being due, not to a dearth of nutritive elements in the ration tried, but because of lack of palatability.

The water contained in food and drink serves to carry nutrient materials from the digestive tract to the tissues, to dissolve the urea coming from the breaking down of body proteids, and to regulate the bodily temperature by evaporation. Another source of water for the body is that coming from the oxidation of materials within the cells of the body; nine parts of water are formed for each part of hydrogen contained in the material so oxidised. Both the oxidation of the protoplasmic material and the production of water tend to decrease the concentration of the solution within the cell wall, and favor the transfer of new material to the depleted cell by osmosis.

It is a well known principle of animal nutrition that animals on a protein diet need more water than do those on a fat and carbohydrate diet, a fact easily explained by the relatively smaller hydrogen content of proteids. Persons travelling in places where water is not obtainable will doubtless reduce their suffering by living on a diet consisting mostly of fats and carbohydrates. [5]

A compilation of analyses of various foods was issued a few years ago by the Office of Experiment Stations, Bureau of Agriculture, at Washington. [6] Analyses of East Indian foods are collected in a recent bulletin. [7] Various tropical fruits have been studied, for example the pineapple [8] and banana. [9, 10, 11] Considerable attention has been given the soja-bean, and the consumption of this article of food is said to be increasing greatly. This highly nitrogenous foodstuff nicely supplements the rice diet so common in the Far East. The soja-bean cake has been studied by Gibbs and Agcaoili, [12] who give a number of references to the literature. Soja-bean flour has the following composition: [13, 14] Protein 44.6 %; fat 19.4 %; sucrose 9.3 %; starch and reducing sugars are absent, a fact which has suggested the use of this material as a food for diabetic patients. Soja-bean milk has the following composition: [15] Protein 4.87 %; nitrogen-free extract 4.83 %; water, 89.29 %; ash, 0.48 %.

The different constituents of our food are reduced to simpler bodies during their

passage through the intestinal canal by the action of substances called enzymes. The latter have been classified, the products of their activity are known, and some of the conditions affecting the rate at which they work. Nevertheless no enzyme has ever been prepared pure, the chemical nature of enzymes is still undetermined, and a list of researches published within the last year on enzyme action would occupy a full page of this periodical.

The nitrogen assimilated by the body is usually assumed to be nitrogen of proteids, but experiments carried out by Armsby [16] and Abderhalden [17] indicate that even ammonium salts may be utilized, possibly because of their intermediate conversion to proteids by bacteria of the intestinal canal. Nevertheless the subject of nitrogen assimilation needs much further study before we can say what kind of nitrogen compounds are available for nutrition, and what kinds are useless or even injurious. Certain vegetable proteids (those of wheat, barley, etc.) are probably fully as nutritious as the proteids of animals, while others (those of leguminous plants) may be less valuable, [18] but the whole subject needs further investigation. Evidence seems to accumulate, however, that a mixed diet is to be preferred to one of purely vegetable foods.

A good deal of attention has been paid to the supposed relation between beri-beri and lack of phosphorus in certain diets. [19] Reports show that the percentage of phosphorus is low in the rice used in districts of India where beri-beri is common. [20] Unpolished rice contains about 0.65 per cent of phosphoric acid (P_2O_5), while polished rice contains as little as 0.26 % of the same constituent. Chickens or pigeons fed upon a rice diet poor in phosphorus will sicken quickly, but thrive well if the proportion of that element in their food is increased.

Little experimental evidence has been collected as to the kind of diet best suited to residents of tropical countries, though it is usually assumed that the proportion of fats and proteids in such a diet should be less than in the temperate regions. [21] Work published by McCay [22] seems to show that those Indian races have the best physique which consume relatively larger amounts of nitrogenous food, and there is little doubt that the diet of many races of the East would be improved by the addition of milk or some other food rich in phosphorus, nitrogen, and mineral salts. Progress in sanitation in such countries should be accompanied by an effort to introduce into the local diets a greater variety of food, better cooked, and more correctly balanced.

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The Growth Of Maize On Cogon Soil

By Andres F. Navarro.

Since the opening of the College of Agriculture, maize has repeatedly been grown as a first crop on land which had previously been occupied by grass and brush. These trials have always resulted in patchy, uneven stands. In general it has been found that the more completely the land had previously been occupied by cogon, the poorer was the yield of the first crop of maize raised upon it. It is reported as experience throughout the islands that this type of soil behaves in this way. The cause of its infertility has never been well investigated, and no satisfactory method of reclaiming it has been developed. The usual practice, when the trouble is taken to bring such land into cultivation at all, is to get such returns as possible from the first crop and to wait for the second or third, when the cogon shall have been nearly killed out, for a crop which will pay the expense of production.

It is well understood that soil problems are complex and hard to deal with. Recent advances in knowledge or theory have been the demonstration of the dependence of

fertility in many soils upon the activity of nitrifying organisms, and the proof that at least in some cases toxic substances excreted from some plants prevent the thrifty growth of others. A group of investigators at Washington have been accumulating evidence for years to the effect that soil in which grasses have been growing is in general a poor one for other crops, and even becomes such for some of the grasses themselves. This view has been confirmed as far as grass and apple trees are concerned, by eight years of work at the Woburn station (Rothamstead), which led to the conclusion that "the action of grass upon apple trees is not merely a question of starvation in any form, nor of any simple modification of the ordinary conditions upon which a tree can thrive, but that grass has some malignant effect on the tree, some action akin to that of direct poisoning."

In the Philippines, cogon lands are so abundant, and often so near to centers of population, that the stranger is always puzzled by their presence. To bring them into cultivation often involves more labor and more expense than to raise a crop on land previously covered with woody plants. In spite of this, they would not remain generally neglected if the return for the labor demanded were not so meager. In the hope of obtaining suggestions as to possible improvement in field practice, a series of pot cultures has been carried through during the past year.

The pots used were well burnt earthen ones with a capacity of 6 kilograms. Into each was put an amount of soil equivalent to 5 kilograms air dried. This soil was taken from a piece of ground densely covered with cogon. The surface soil on this area is loam to a depth of 15 to 25 centimeters. The subsoil is a reddish yellow clay, a residual product of sedimentation and the decomposition of tuff. The soil used in the pots was taken at a depth of 20 centimeters, by means of a post-hole digger. The samples were freed from cogon roots and stems, passed through a sieve with 5 mm. mesh, and the soil for the whole series thoroughly mixed on a cement floor.

The pots were divided into series as follows: 4 pots for control; 8 pots for an ammonia-leached series; 8 pots for a water-leached series; 8 pots for a burnt series; 7 pots for a normal fertilized series; and 3 pots for metallic stimulants.

The water-leaching process lasted two weeks. Creek water was used for the purpose. The ammonia-leaching lasted longer, the strength of the ammonia being 4%. Five liters of the solution was used to leach each pot in the series. The excess of ammonia was removed by leaching with water. The burning of the soil was done on galvanized sheet-iron.

The chemicals used as fertilizers, alone or in combination, are, in each pot: Potassium nitrate, 25 grams; dicalcium phosphate, 25 grams; magnesium sulphate, 25 grams. At this rate, the computed application per hektare is 11.65 metric tons of each salt.* As possible chemical stimulants, the chlorides of zinc, mercury, and copper were used, and amounts calculated respectively as equal to M-1000,

* This is based on an assumed air dry weight of soil of 2330 tons per hectare.

TABLE I

Growth of the Most Rapidly Growing Leaves of Each Pot.

Culture No.	Treatment	October													November													Average	Relative Growth	Height of plants mm.	Number of Leaves	Interval between leaves, days.
		18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14					
I	Control	49	50	58	50	48	46	49	46	44	42	40	32	32	37	44	43	49	47	42	60	57	59	60	75	50	33	30	51	....	.....	706	9	4
II	Control	41	58	49	44	45	48	45	42	40	40	39	32	32	42	40	48	48	54	44	49	54	59	62	54	45	33	28	47	....	.....	702	8	3 1/7
III	Control	40	42	94	35	37	42	37	37	35	31	30	25	48	48	10	30	45	25	24	25	27	32	31	36	34	28	29	41	42.5	100	505	9	4 3/4
IV	Control	38	48	44	42	41	44	43	41	34	18	39	88	25	41	50	55	40	34	26	36	76	57	39	35	25	29	32	44	....	.....	532	9	3
V	NH_3 leached control	31	32	22	28	21	9	16	8	13	9	10	6	6	5	5	6	6	3	..	3	6	..	10	6	4	n	..	5	11.0	23.27	202	4	4
VI	NH_3 leached + K. N		26	42	47	39	18	37	24	34	21	22	6	6	7	8		3	..	..	..	9	..	3	3	..	..	..	2	19.3	45.41	257	6	6 3/7
VII	NH_3 leached + CaP.	32	33	26	33	31	12	32	18	29	19	21	18	18	16	32	29	36	30	24	40	48	62	80	82	58	35	41	64	35.2	82.58	570	10	3 4-7
VIII	NH_3 leached + MgS	39	41	29	36	31	12	33	24	19	13	11	5	5	10	6	5	7	8	6	4	1	..	4	1	..	5	..	5	14.0	30 58	145	5	6 1/7
IX	NH_3 leached + KNCaP.	31	30	36	42	30	28	41	30	23	23	11	1	1		D		e	..	..	a	..	d	d	..	..	..	..	..	25.1	59.05	209	4	3
X	NH_3 leached + KNMgS.	26	44	46	46	41	33	46	32	23	26	21	6	15	4		D	..	e	..	a	..	..	..	..	..	..	..	..	29.2	68.70	325	5	4
XI	NH_3 leached + CaPMgS	29	29	25	27	23	24	18	14	14	12	8	2	3	2	8		..	2	12	8	7	5	..	8	5	2	..	..	12.4	29.17	176	5	7 1/2
XII	NH_3 leached + KNCaPMgS.			27	55	26	36	26	36	27	23	6	7	5	2	90	..	D	..	e	..	a	..	..	d	..	..	..	..	28.	65 76	318	5	6
XIII	Water leached control	41	34	34	37	39	37	35	33	30	32	26	28	28	20	21	21	24	23	17	15	20	21	22	21	21	16	16	23	26.6	62 35	387	7	6 1/7
XIV	Water leached + K.N.	20	49	51	54	41	40	46	35	35	33	30	27	28	21	22	32	24	26	18	15	18	22	24	24	18	22	19	23	29.1	68.47	403	7	4 1/7
XV	Water leached + Ca. P	56	57	51	49	55	59	61	70	69	75	67	67	67	58	65	59	73	44	36	27	51	41	49	36	26	10	54	49	52.9	124 44	760	11	3 3/7
XVI	Water leached + MgS	59	60	58	58	51	50	43	42	39	29	25	22	23	21	30	22	22	22	22	26	18	26	27	23	22	20	130	27	36.3	85.17	460	13	2 3-5
XVII	Water leached + KNCaP.	25	43	36	43	36	34	42	37	40	57	50	56	56	52	78	78	81	72	55	63	90	93	88	86	72	15	67	80	58.1	110.82	848	9	4
XVIII	Water leached + KNMgS	20	35	32	42	30	25	29	30	31	33	29	23	24	20	26	24	22	19	20	21	26	24	23	32	20	17	23	24	25.8	60.77	363	7	4
XIX	Water leached + CaP.MgS	59	62	53	54	58	64	66	68	67	70	75	69	71	80	78	74	85	195	37	36	64	70	107	90	52	30	45	48	65.6	154.04	875	13	2 1/7
XX	Water leached + KNMgsCaP	19	39	37	42	36	25	37	40	48	39	43	40	40	42	59	54	69	57	49	57	69	87	95	82	58	35	60	77	50.5	118.82	775	12	2 7-9
XXI	Burnt Control	39	42	41	38	39	40	41	41	37	36	32	30	30	29	38	11	38	35	42	33	20	38	46	45	45	32	31	35	40.4	95 4	505	9	3 5-6
XXII	Burnt + KN	45	50	46	47	45	45	43	41	40	61	21	32	33	29	48	38	40	35	33	34	33	36	50	50	42	44	34	48	40.7	95.74	592	9	3 1/7
XXIII	Burnt + CaP	37	47	48	59	57	63	59	73	72	72	72	73	73	60	93	86	63	45	8	29	74	90	104	83	40	12	22	100	61.3	144 21	865	12	3
XXIV	Burnt + MgS	34	45	48	47	50	56	55	53	49	53	45	39	39	36	46	49	50	47	28	36	36	57	90	48	42	32	38	48	46.2	108 70	655	10	3 3-7
XXV	Burnt + K.N.CaP.	50	58	50	54	61	55	54	61	65	59	72	23	23	50	43	51	86	59	68	35	75	94	109	86	72	37	58	85	60.4	142.11	954	13	2 3-10
XXVI	Burnt + N.N.MgS	18	49	46	43	46	47	45	43	42	35	18	28	29	45	12	43	41	55	34	34	36	42	40	44	31	30	41	47	40.1	94 35	607	9	3 1/7
XXVII	Burnt + CaPMgS	11	73	51	56	56	68	64	74	73	75	81	31	31	112	102	196	87	69	68	32	80	102	178	90	57	140	90	85	67.6	160.05	1005	13	2 1/7
XXVIII	Burnt + KNCaPMgS	10	52	50	49	54	59	61	64	66	69	67	62	62	50	71	65	72	61	44	99	36	79	88	53	30	45	45	75	58.5	117.64	895	12	2 2/7
XXIX	Normal + KN			36	36	31	24	26	25	31	25	42	22	23	27	36	33	31	33	25	33	40	50	45	60	35	42	55	40	34.8	90 37	535	9	3 5-6
XXX	Normal + CaP	31	56	50	59	63	61	62	78	74	78	81	33	34	59	96	72	90	60	15	60	53	65	96	65	43	40	41	97	61.2	144.	990	12	3
XXXI	Normal + MgS	31	54	42	48	44	48	49	44	41	38	33	27	28	26	41	36	57	35	34	37	58	59	50	45	34	33	35	40	40.9	96.23	597	9	3 2/7
XXXII	Normal + KNCaP		41	44	39	40	38	43	51	56	52	60	61	124	64	69	79	77	58	31	35	50	76	81	52	73	30	75	82	61 8	145.40	825	12	2 8-9
XXXIII	Normal + KNMgS			32	34	33	22	33	32	34	33	29	22	23	33	26	36	23	19	15	29	21	20	23	20	15	17	22	20	25.2	59.29	330	7	4 2/7
XXXIV	Normal + CaPMgS	40	46	42	45	44	56	51	38	77	69	64	31	32	75	79	66	69	56	45	43	55	49	61	52	43	28	62	55	52.2	123 06	878	11	3 3/7
XXXV	Normal + KN.CaPMgS				39	35	17	40	25	21	23	20	22	22	5	13	3	2	5	3	..	..	..	..	..	..	..	..	..	..	18.4	43 29	245	5	5
XXXVI	Normal + $ZnCl_2$				28	27	18	22	32	29	38	17	20	21	23	29	34	30	25	25	15	25	21	14	16	20	12	19	23	23.3	54.82	292	8	4 1-5
XXXVII	Normal + $HgCl_2$				5	11	10	10	11	11	10	10	11	11	8	15	12	15	15	10	6	22	23	31	24	15	30	20	30	13 4	30.11	300	6	5 1/7
XXXVIII	Normal + $CuCl_2$				5	9	10	14	14	17	10	27	25	25	25	30	29	34	28	17	30	31	44	49	35	30	28	37	45	25.9	60 94	375	8	3 2-5

M-50,000, and M-5000. These were the concentrations found by Mr. Roxas to be most effective in stimulating the growth of rice. The rate per hektare of these applications is 46.6 kilograms, 242 grams, and 1.228 kilograms. The seeds were planted directly in the pots four days after the application of the fertilizers and stimulants. The pots were then placed in a well lighted place and liberally watered, but with care to avoid any excess which might cause leaching. From the appearance of the third leaf, growth measurements of individual leaves were taken daily. This record began October 17th, and ended November 14th, when the cultures were destroyed. This record is given in concise form in Table I.

The control plants in pots I-IV showed an average daily growth of 42.5 mm., and this growth was decidedly uniform throughout the course of the experiment. Such irregularities as occurred are for the most part due to changing the leaf which furnished the measurement. Each leaf when it first appears is growing most rapidly. Its decrease in rate is often rather abrupt before its place is taken by the next younger leaf. These plants showed the characteristic behavior of plants grown in the field on cogon soil. The most characteristic symptom is the dying of the tips of the leaves.

The plants grown in soil leached with ammonia, in pots V-XII, did not on the whole thrive by any means as well as those in untreated soil. Treatment with fertilizers failed to bring any plant in this series up to the standard of the controls. The reason for the poor growth of this series is not clear. It is not due to incomplete removal of the alkali, since test showed the reaction of an extract of this soil to be slightly acid.

Leaching with water was likewise without beneficial results. However, in this series, four of the fertilized pots showed improvement over any of the control plants. Used individually, the most effective fertilizer was calcium phosphate, and it was probably also the most valuable in combination. Magnesium sulphate used by itself and in combinations without calcium showed itself to be injurious. On the other hand, when used in combination with calcium, as in Pot XIX, it proved itself distinctly beneficial. This evidence is entirely in accord with the teaching of Oscar Loew and the Japanese school. Plants treated with a combination of all the fertilizers used did not do as well as some of those receiving a partial fertilizer. They were conspicuously green and of good appearance, and their failure to grow as well as some of the others was presumably due to too great a concentration of salts in the soil water.

By far the best growth was shown by the plants grown on burnt ground although even in this case the unfertilized plant was not quite up with those grown in untreated soil. The effect of the different fertilizers was similar to that observed in the series leached with water. The leaves of the plants in this series were conspicuously large, thick, and green, and the stems were stout and stiff. The plants in Pots XXIII, XXV and XXVII developed suckers, which no other plants in this experiment had time to do. The chief cause of the thrifty

growth of the series in burnt ground was probably the improvement in the mechanical condition of the soil, the clay in which was dehydrated and the whole reduced to a sand-like consistency. The hypothetical injurious substances in the soil are presumed to have been destroyed.

The metallic salts tested as possible stimulants all showed themselves to be injurious. The zinc was least harmful and the mercury most so, in the concentration used. The plant treated with copper showed a very noticeable improvement toward the close of the experiment. It is concluded that these poisons were used in too great concentration; and that therefore corn is more subject to poisoning, at least by these substances, than is rice. Previous investigation has also indicated that this is the case.

To answer certain questions which were not considered in the arrangement of the preceding set of cultures, and in the hope of making observations which should include the yield, another set was started in the same pots, and in soil taken from the same field. So far as is not otherwise stated, the treatment of the soil was also the same. This series was so planned as to determine a possible deficiency in any of the essential food elements, the effect of sterilization by other methods as well as by burning, and the effect of manures. The following table shows the treatment of the several plots and gives a summary as to growth and productiveness in each. As in the first series, daily measurements of growth were made from January 8th to February 21st, but the detailed measurements are omitted here.

The chemicals and manures used were applied to the pots in quantities calculated as equivalent to the following amounts per hektare:—

K_2SO_4	446 Kg.
$NaNO_3$	446 Kg.
Na_2HPO_4	446 Kg.
$CaCO_3$ (commercial)	22.3 tons
Na_2SiO_3	2.23 tons
Stable manure (1)	223 tons
Stable manure (2)	446 tons
Stable manure (3)	669 tons
Worm excrement (1)	223 tons
Worm excrement (2)	446 tons

The carbon bisulphide and ether were mixed with the soil and were then allowed to evaporate by spreading the soil out in a thin layer. The stable manure was obtained from a stable in the neighborhood in which the horses were fed a little corn and enough grass. The silk worm excrement was obtained from the silk house of the college.

To overcome the difficulty encountered in the first series in obtaining an even germination, the seed for this series was germinated in clean sand; the seed was planted in this, December 27th, and the seedlings transplanted to the pots, January 6th. Growth measurement began January 8th, and as already stated were made daily to February 21st, and weekly after that date. Practically all of the plants bore the slender stems and narrow leaves and showed the characteristic yellowing of the leaves of plants grown on cogon land.

The only one of the three elemental foods tested separately as to their value, the use of which resulted in a considerable acceleration of growth, was nitrogen. The plants treated with sodium nitrate showed a relative growth as compared with the controls of 151 during the first interval of the measurements, and 174 during the final one. The plant given a complete fertilizer showed a relative growth of only

TABLE II

Growth of the Most Rapidly Growing Leaves of Each ot.

Culture	TREATMENT	Ave. Growth Jan. 8 to Feb. 21	Rel. Growth	Feb		March					Ave. daily Growth	Rel. Growth	Total no. of leaves prod.	Height to cip of trees	Rel. higts of plants	No. of developed	Green wts. of tops	Rel. weights
				27	29	1	4	11	18	25								
I	Control	.....	.....	71	77	63	50	132	13	2	.....	.....	....	727	.....	No.	20	.....
II	Control	.....	.....	103	42	48	57	89	15	5	.....	.....	....	611	.....	1	24	100
III	Control	28.8	100	6	43	75	77	120	3	3	10.3	100	....	729	100	1	25	.....
IV	Control	.....	.....	55	183	10	25	167	18	10	.....	.....	....	991	.....	1	44	.....
V	K	28.0	98	110	47	61	57	41	12	5	10	96	15	638	83	No.	22	91
VI	N	43.6	151	127	188	107	172	21	6	4	18	174	16	1085	142	1	48	200
VII	P	29.0	101	108	57	58	59	45	16	3	13	126	15	504	67	1	29	120
VIII	K. N	36.3	126	131	29	79	109	86	30	7	14	136	15	954	125	1	43	179
IX	K. P	28.8	100	64	49	19	5	39	12	7	6	58	15	684	90	1	22	91
X	N. P	36.2	126	128	44	88	107	204	20	2	18	174	15	1095	143	1	57	112
XI	K. N. P	38.0	132	144	25	132	110	160	18	4	18	174	15	1113	146	1	58	241
XII	Water leached K	22.4	78	107	38	39	10	140	16	7	3	126	12	481	63	1	17	70
XIII	Water leached N	32.0	111	151	47	63	49	44	12	3	12	116	16	653	98	1	27	911
XIV	Water leached P	21.0	73	124	43	43	36	90	19	3	11	106	12	533	80	1	13	60
XV	Water leached K N	23.8	82	142	42	47	33	128	20	5	12	116	11	658	98	1	17	70
XVI	Water leached K P	22.1	77	104	33	32	32	92	18	7	10	96	12	463	60	1	14	58
XVII	Water leached N.P	25.4	88	35	37	35	32	52	8	6	6	58	11	510	67	1	20	83
XVIII	Water leached K.N P	32.9	114	121	74	52	82	99	14	7	13	126	13	885	116	1	45	189
XIX	NH_3 leached Control	.....	.....	.....	.....	.....	Dead	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
XX	NH_3 leached K.N.P	.....	.....	.....	.....	.....	Dead	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
XXI	$CaCO_3$	36.7	127	62	80	80	76	205	21	6	16	155	13	972	128	1	78	325
XXII	$CaCO_3$ K.N.P	42.7	146	184	82	108	96	137	20	3	19	184	15	987	139	1	93	387
XXIII	$NaSiO_3$	26.0	90	106	38	35	28	11	5	5	10	96	11	387	50	No.	17	80
XXIV	$NaSiO_3$ K.N.P	34.5	120	79	16	95	78	109	10	5	12	116	13	961	126	1	42	175
XXV	Stable manure, 500 gr	38.1	132	56	86	118	123	168	6	6	17	164	4	1045	137	1	56	233
XXVI	Stable manure 1000gr	42.6	144	65	100	78	6	21	12	4	8	78	14	1058	139	1	83	345
XXVII	Stable manure 1500 gr	46.7	162	97	69	95	45	43	18	10	11	106	16	1063	140	2	122	507
XXVIII	Worm excrement, 500 gr	30.2	105	149	50	55	30	235	10	7	16	155	12	853	112	1	52	216
XXIX	Worm excrement, 1000 gr	37.0	128	132	74	69	65	79	25	3	13	126	12	1053	138	1	100	416
XXX	Burnt	40.7	141	174	117	149	7	181	20	4	19	185	15	1074	143	1	64	266
XXXI	Burnt K.N.P	59.0	204	280	230	60	39	30	13	6	19	185	16	1373	180	2	155	646
XXXII	Ether Treated	36.8	127	118	122	45	60	29	4	2	12	116	14	772	101	1	42	175
XXXIII	Ether Treated K.N.P	44.6	154	34	104	126	117	131	26	5	16	155	14	1198	157	1	72	300
XXXIV	CS_2 treated	40.5	142	30	72	80	77	80	12	4	10	96	14	1103	142	1	76	315
XXXV	CS_2 treated, K.N.P	41.8	145	92	86	97	82	196	25	6	18	174	15	1055	139	1	92	383

132 during the first interval, and 174 during the second.

The plants in the Ammonia-leached series died early in the course of the experiment. Those in the water-leached series were very stunted, but were greener on the whole than plants in the other pots. In this case again, the application of nitrogen proved useful. The application of calcium carbonate was decidedly beneficial, although not in the same degree as that of calcium phosphate in the first series of cultures. Sodium silicate used alone resulted in a decrease in the rate of growth.

The use of stable manure resulted in a decided increase in the rate of growth and in improvement in the general appearance of the plants. The use of the larger quantities of manure was followed by a still further increase in growth, but this increase was naturally not in proportion to the increase in the quantity of manure applied. Worm excrement was at first less effective than stable manure, but toward the end of the experiment proved more so.

Burning the soil resulted in a great improvement, just as it did in the first series. Sterilization with ether also proved very beneficial, although not as much so as sterilization with carbon bisulphide. The leaves of the plants grown after treatment with the latter substance were conspicuously green.

CONCLUSIONS.

The application of lime to cogon soil is decidedly beneficial.

The cogon soil used was deficient in nitrogen in whatever form.

The application of manure, obtained from the stable or the silk-worm house, results in much more active growth.

The sterilization of the soil is beneficial.

Various methods of improving the growth of maize on cogon land have been found, but no practical solution of the problem undertaken.

I desire to express my obligation to Professors Copeland and Deming, and to Mr. Cuzner for assistance in this work.

The Philippine Agriculturist and Forester

Organ of the Student Body of the Philippine College of Agriculture, Published Monthly During the School-year

ENTERED AT THE POSTOFFICE AT LOS BAÑOS, LAGUNA, AS SECOND CLASS MAIL MATTER

₱2.00 A YEAR — 25 CENTAVOS A COPY

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Address all communications to the Business Manager LOS BAÑOS, LAGUNA.

Foreign Subscription: 1.50 dollars a year.

EDITORIAL

The editors of the AGRICULTURIST AND FORESTER tender to subscribers and readers their apology for the long delay in the appearance of these numbers, and for their defects as they appear. This delay is due first and in smaller part to a change of quarters by the printer, and secondly to the absence in the United States of the Dean of the college, who is under the Regents of the University responsible for the publications of the Student Body. As this composite number goes to press the copy is already in sight for all of the numbers needed to bring the journal up to date, and it is expected that these will appear in rapid succession until the number of each issue again corresponds with the calendar. To do this, it is necessary to publish them in groups instead of singly. This involves a loss of two-thirds in the receipts from advertisers. In the past it has been the receipts from advertisers which have made it financially possible to publish this journal. We are accordingly made dependent, in a way that has not hitherto been the case, upon the support of subscribers. We trust that the explanation and apology for the delay will be acceptable and that subscribers will remit without further solicitation.

Numbers 4, 5 and 6, to comprise seventy-two pages, are already in press.

THE PHILIPPINE AGRICULTURIST AND FORESTER was founded two years ago by the Student Body of the College of Agriculture of the University of the Philippines. Its objects, as were stated in the first issue, are to help in the development of agriculture in this country, to assist the Filipino man and his family to know how to live comfortably, happily and independently on the land, and to provide a place of publication for such practical information in agriculture or agricultural education as may be developed in this college. It is the conviction of the Student Body that the progress of our people, the degree to which our civilization can be developed, and the approximation of our ideals, depend not alone upon the diffusion of knowledge, but to an equal extent upon the realization of such a measure of material welfare as will make the lives of our people cease to be a burden of labor too severe to permit the satisfaction of higher wants than those of the body. To reach this measure of material welfare, it is necessary that our vast waste lands be converted into gardens, whose gardeners shall be the Filipino people.

In our first volume, we have published the results of experiments carried on by students, papers on agricultural subjects by students and faculty, reviews and digests of such current literature as seemed to have a value in the agriculture of the Philippines, and suggestions and directions for gardening. So far as the space of the one volume

permitted, we have covered what we consider our proper field. There is more room in two volumes than in one, and with time we expect to cover our field more thoroughly. Thus in the forthcoming volume, more attention will be given to foresty and to animal husbandry than was possible in the past. However, our bid for the support of our people is based primarily on the record made by our first volume.

During the interval since the appearance of the last number of this journal, the faculty of the college has received some very important additions. The first of these was the filling of the associate professorship of Agricultural Engineering. The new faculty member is Mr. Albert G. Glodt, who received the degrees of Civil Engineer and Master of Engineering from the École Centrale des Arts et Manufactures, Paris. Mr. Glodt was trained for the Engineer Corps of the French Army in which he served for some years. His most notable work in that distinguished organization was as a member of the Marchand Relief Expedition across Africa. Of the little band of officers who made this remarkable expedition, Mr. Glodt was one of the two who survive without more serious injury than the loss of part of a hand.

Since leaving the Army he has engaged in a variety of engineering enterprises in the United States, in all of which he earned marked advancement. He comes to the college from the place of District Engineer in the Bureau of Public Works from the provinces of Pampanga, Tarlac and Pangasinan.

The addition of a trained engineer to the staff of the college has made it possible for the institution to take over, under the general authority of the Director of Public Works, the permanent improvements of all kinds which have continually to be built upon its grounds. The long awaited water system of the college has been completed under his direction so that we have now for the first time proper facilities for the work of the laboratories, and the water supply for the field which is necessary for the continuance of active and successful work during dry seasons. The Power House of the college, also long awaited, has just been completed, and a new building to serve partly as a barn and also for class room purposes of the department of Animal Husbandry is now in course of construction.

The American system of engineering education has proven admirably adapted to the production of competent practical engineers, but the technical instruction is, as a rule, based on preliminary academic training so inferior to that which obtains in Europe that the product is in general without the general breadth of education which ought to be demanded of a member of the college faculty. The college is decidedly fortunate in filling this place with a man of European training, American experience, and demonstrated capacity for hard work. Mr. Glodt arrived in July.

For the chair of Agronomy, Charles F. Baker has been secured after several years of continued effort. There are few, if any, men who have a wider knowledge of tropical crops, and perhaps none who combine the requisite general training for this college chair with as wide a variety of experience with tropical agricultural and economic conditions. Besides some years of work as botanist of the Cuban Experiment Station, and a residence in Para during which he organized an Agricultural Experiment Station for the State, Professor Baker has traveled extensively in other tropical American regions, and during the last few years has maintained in Southern California a station whose chief activity was in experiments looking to the acclimatization of supposedly tropical plants. We shall print in a later number a statement showing how California feels his loss.

Professor Baker took up his work in Los Baños near the end of August.

Frank Caleb Gates, the new Instructor of Plant Physiology, arrived in September. His training has been at the University of Illinois and the University of Michigan, from the latter of which he has recently received the degree of Doctor of Philosophy. Dr. Gates' published work has been chiefly in the field of ecology.

The Annual Report of Farm Work

Prepared from the Notes of Inocencio Elayda, B. S. A., Instructor in Agronomy and Farm Foreman

The annual report of Mariano Manas, farm foreman of the College of Agriculture for the fiscal year 1911, was published in August, 1911, number of the PHILIPPINE AGRICULTURIST AND FORESTER.

During the year 1912 there has been an appreciable increase in the amount of labor available. As a result it has been possible to extend the area in cultivation and to give very much better attention to all of the fields. The year has been characterized by a very exceptional drought as is shown by the following table of rainfall by months.

RAINFALL

Month.	Total	Rainy days
September	130.0 mm.	14
October	32.5	12
November	18.29	7
December	55.4	13
January	38.9	13
February	44.7	12
March	13.0	5
April	3.3	1
May	154.4	7
June	81.0	13

The Irrigation plant of the college, which for two years we have been in constant expectation of seeing completed, has not yet begun to supply water. The exceptional drought and the unanticipated want of water available for irrigation resulted in the total loss of some crops and in a very unsatisfactory yield from various others. Details as to these failures will be noted in connection with the several cultures.

THE GRASS FAMILY

SUGAR CANE.—From the purple cane which furnished the material for the graduating thesis of Mr. Tempongko,* tops were selected by Mr. Asunción and planted in 22 plots, each of 1-20 of an hektare. These were treated with a variety of manures and the results, so far as conclusions could be drawn, are embodied in the graduating thesis of Mr. Asunción, also to be published in the Journal of Science. While the work of Mr. Asunción was carefully carried on, the actual behavior of the plants on the several plots was such that the experiment as a whole was singularly inconclusive. Or, if any conclusion must be drawn, it would have to be that the fertilizers used were without definite effect. A rattoon crop is now being raised on the same field.

Two other strains of sugar cane, a red and a white variety from cuttings sent by the Bureau of Agriculture, are now growing in the nursery.

TEOSINTE (*Reana Luxurians*).—A test of germination of seed of Reana luxurians was made July 31st, 1911, giving 94% germination. October 31st, there were planted four rows six meters apart, the total area being 45 sq. m. The seedlings appeared above ground November 8th, and headed January 1st, 1912. They were harvested March 30th, the height of the plants averaging 120 cm. The yield of shelled seeds was 1.5 kilo equal to 333 kilos per hektare.

SORGHUM.—Sorghum has in the past proved a uniformly satisfactory crop on the college farm. This year there were

* To be published in the Philippine Journal of Science.

two plantings, both of which started well but were afterwards so stunted as a result of drought that they were plowed under.

Kaffir corn did somewhat better. It stooled considerably, and produced an average of four heads to the plant, each head weighing 200 grams. This also was plowed under

Maize.—Maize of all varieties has produced four crops during the past year. The most careful experiment with it was the work done by Mr. Vibar for his graduating thesis published in Vol. 1, p. 175 of the Agriculturist and Forester. Attempts to carry on selection work for the development of improved strains of maize have been made on a reasonably large scale, but under climatic conditions so abnormal that the results are probably almost valueless. At the end of the year there are three fields planted with selected native seed after the beginning of the rains. Seed for this work has been obtained in the neighborhood of the college. Only the middle kernels of the ear have been used for seed. The fields were marked and cross-marked at distances of one meter to facilitate regular planting and cultivation in both directions.

The first field was planted May 29th, and germination, about 98%, occurred June 1st; area 7524 sq. m. The second field was planted June 11, and germination, about 92%, is dated June 14th; area 4700 sq. m., The third field, area 1242 sq. m., was planted June 25, and germination to date is about 85%.

Forage.—Guinea grass has not been harvested during this year in a way which permitted determination of the yield. The farm animals have at times been turned on it to pasture, and at other times small patches have been cut and fed. The old fields have been plowed under during the year. The root system of guinea grass is exceedingly thick and very tightly fastened in the soil so that it is a very difficult crop to clean from the field. If the clumps are plowed out, it is still impossible to break them up with the harrow and if the land is to be used again immediately, it is necessary to gather the clumps by hand and carry them from the field.

Moras (*Andropogon zizanioides*).—Of the 179 plants set out in July 10, ten consecutive ones were dug up in January 12th for analysis to determine the oil content. This analysis was made by the Bureau of Science in Manila with the following result:

VETIVER ETHEREAL EXTRACT

Sample.	Per cent of Extract in air dry Root.
No. 1	8.08
No. 2	7.26
No. 3	9.01
No. 4	8.31
No. 5	7.18
No. 6	9.55
No. 7	6.96
No. 8	8.57
No. 9	7.52
No. 10	8.23

The stools represented by samples Nos. 3, 6, and 7 were divided and planted January 20th, 1912, each plant making two rows. By means of hand watering all of the plants were made to survive the drought and they are now growing well.

ROOT CROPS

Cassava.—*Manihot utilissima*. Cassava has been grown on three fields during the past year. There are no definite and reliable returns as to the yield from any of these; one of them was reached by wild hogs and some feeding was done from all three before they were finally harvested. Some starch was made and an exhibit of it was taken to the Philippine Exposition. The varieties with which work was done

were the red kapo, white kapo and kamunting, all of which came originally from the Moro Province, and the local Laguna variety. In the field planted September 13th and October 7th, germination was 50 to 73 per cent. In reasonable moist ground, and with occasional rain, a better germination than this can always be obtained. The Department of Animal Husbandry reports that the fresh roots have proven an acceptable and valuable feed for both hogs and chickens.

Sweet Potatoes.—As compared with the yield of 8200 kilos obtained during the preceding year, the best that has been realized during this year was 6300 per hektare. This was from the field planted August 4th, where growth was well begun before the rains ceased. On an area of 2520 meters planted in December it took 29 days for the cuttings to become established and the growth was slow and scattering. The crop was finally harvested June 27th, after the rains of this season were well under way. The time required by this crop was abnormally long and the yield was only 807 kilos at a cost of ₱27.94.

There are now growing in the nursery a number of varieties of native sweet potatoes obtained at the exposition from various parts of the islands. With these and with other varieties which he has collected, Mr. Muñoz is preparing his graduating, thesis.

Yams.—*Dioscorea hirsuta Blume.*—The native plants known as *kalut* and *nami* seem to belong to this species. From five plants in the nursery an average of 4.4 kilos of tubers per plant were harvested March 2nd. This is the quickest growing and most resistant to adverse weather conditions of all the yams grown on the farm.

Tugui.—The original stock of this consists of 6 tubers planted March 5th, 1911, which germinated in 15 days. They yielded an average of 1.8 kilos per plant. For the second generation crop, four tubers were planted February 17th, 1912, and sprouted after 24 days.

Dioscorea alata.—This seems to include the native *ube binaksan, ube kinampay,* and *ube kabusok.* Of *ube kabusok,* a single large tuber was planted March 5th, 1911. It produced but one tuber which was conical in form, and four big branches emerging from its tip, with a total weight of 8 kilos. Three tubers of *ube binaksan* were planted March 15th, 1911, and sprouted March 28th. The yield was 4.3 kilos of tubers per plant. Tubers planted February 17th, 1912, sprouted after seventeen days. Of *ube kinampay,* three crops have been raised here. Another form known as *ube labe,* or *imbid* from Liloan, Cebu, is being tested for the first time. *Abobo* is another yam of which five smooth tubers, resembling Irish potatoes, were obtained at the exposition. Four of these were dark in color, and the other much lighter. They were planted February 16th, and sprouted April 8th, 1912. In habit of growth and in shape and color of leaf, it resembles the *ube kabusok.*

Gabi.—The material of Mindoro gabi (*Colocasia antiquorum*), and Yautia (*Xanthosoma*) was propagated for a year in the college nursery, until there was sufficient to plant a field of this and of the native gabi. The drought and lack of expected irrigation made this planting a complete failure. In the nursery there have been again planted Yautia, Mindoro gabi, and the green and black local varieties. These were heavily fertilized and placed below the nursery ditch. With this treatment the yautia has reached an amazing stature.

From the exposition several more plants of this crop were obtained. Among these is *"Talian tuberculo"* from Samar, apparently an *Alocasia.* It has an erect stem 15 or 20 centimeters in diameter, and more than 1 m. high. There were also

obtained from Samar a form of gabi with smooth black tubers, and another with rough tubers which are now growing in the nursery.

Miscellaneous.—There are also growing in the nursery native ginger and imported Jamaica ginger, arrow root, and *Curcuma*, as well as a few plants of *Tacca pinnatifida*. The last plant reproduces itself here, but in the heavy soil of the college farm does not grow luxuriantly enough to offer any promise as a crop.

LEGUMES

Peanuts.—An area of 1564 sq. m. was planted October 10, 1911, with seed grown on the farm. The date of germination was October 13th, of plowing, November 23rd, and of the first observed fruit, December 15th, and of the harvest, March 23rd to April 23rd, maturity not being uniform. The yield was 55 kilos of cured nuts or 351 kilos per hektare. The low yield is another result of drought.

Two plants were dug before maturity, and the root system examined to a depth of 40 cm. The main roots reach considerably deeper. The root system can be regarded as occupying two strata; the first is about 14 cm. deep and has nodules on the main root. The second zone is below this, and is characterized by very free branching with smaller and less numerous nodules.

Seed from this crop was planted May 27th, germinated June 1st, with 85% germination, and began to flower June 20th.

A variety called *mani isinay* from Nueva Ecija was obtained at the exposition. It germinated April 6th, and began to flower May 8th.

Legume Field.—A definite tract on the college has been set aside for the cultivation of legumes over a term of years. Soil analyses were made from this field before this work began and are expected to be made from time to time as it progresses. This field is divided into units of 1-50 of an hektare, and each kind of legume is planted on one or more of these units.

Sincamas (*Pachyrrhizus Erosus*).—On the field devoted to legumes, 520 sq. m. were planted with sincamas seed December 1st, 1910. Germination was December 8th, with 88%. The crop was ready for harvest March 11th, but was left undisturbed, and new leaves appeared April 20th. The first seed was observed May 2nd, and by July most of the plants were in fruit. The seed was collected beginning October 9th, and thereafter as it matured. The tubers were harvested in January, the yield being 205.25 kilos, or at the rate of 3947 kilos per hektare. Insects bored into many tubers and these are not included in the yield.

Centrosema Plumieri.—The one plant of Centrosema reported by Mr. Manas is still standing in the nursery. Its growth has always been vigorous, even during the drought. Ripe seed has been collected from it three times, the total weight being 3.8 kilos, but no attempt has been made to collect all of the seed.

Soy Beans.—These have been obtained from several sources, and have uniformly given better results than experience elsewhere in the tropics allowed us to anticipate. One of these is now in the third generation. The lot planted December 6th, 1911, germinated December 11, and began to flower December 20th, and was harvested February 28th. Aside from the production of a large amount of green material the harvest of beans was equivalent to 500 kilos per hektare. In some cases much larger yields of seed have been obtained.

Velvet Beans.—These also have proven a quick and strong growth. Planted December 7th, it was harvested April 13th, and the field was then turned over to hogs.

Cagyos (*Cajanus indicus*).—Seed material of this legume was secured from

Batangas and Ilocos Norte. The latter bears brown, somewhat flattened, seeds. That from Lipa bears round seeds which are white, black or mottled, the three color forms sometimes occurring on a single plant.

MIMOSA PUDICA.—This is a common weed here and throughout the Philippines. No cultural work has been done with it, but in view of the opinion sometimes expressed that it has no value, it is worth while to note that in the coconut grove used for pasture, which was originally full of the sensitive plant, it can hardly be found now. The cattle eat the tips or the whole of young plants, in preference to almost any other forage.

CYAMOPSIS PSORALOIDES.—Guar or gawal. Seed was received from the Empress Botanical Garden at Poona, and planted December 12th, 1911. Germination was perfect and the first fruit matured March 7th, 1912. There have been several subsequent plantings. The growth is luxuriant, making a mass of herbage which under favorable conditions is more than 1 meter high. The plant stands drought well and develops rapidly. Before it matures it is subject to fungus attack, and accordingly does not produce a large quantity of seed; but for fodder, especially during dry seasons, it can be strongly recommended here.

PSOPHOCARPUS TETRAGONOLOBUS.—The seed of this plant from different parts of the islands are very evidently of two definite varieties. They have grown well and produced luxuriantly here, but have so far never produced tubers.

BEANS.—A considerable variety of beans are growing on the campus. Of Lima beans there have been several crops. Beside this there are a black bean called *paayap*, from Nueva Vizcaya, a round red bean from the same region, ordinary small white beans, a very small bean with yellow flowers called *sinay*, which is exceedingly productive, "Dolique Mougette," locally known as *batao*, and the local *sitao*, which may be regarded as the "cow pea," and which grows in a number of varieties.

GARDEN VEGETABLES

Garden vegetables of a variety of kinds have been grown in the individual plots, one of which is in charge of each student in the second year Botany class. In these plots, both native vegetables and imported ones are grown. Some of the produce was good enough to receive medals in the keen competition encountered at the exposition. No report of this purely student work is presented here.

The work done in the college nursery was entirely with introduced plants, and was intended only as a test of the possibilities of these vegetables under local conditions. This test during the past year has been an unfair one, because of the unusual conditions. It may have been for this reason or may have been because of the actual unfitness to the normal Philippine climate that practical failure has resulted from the attempts to grow a considerable number of varieties of beets, carrots, melons, squashes, cabbages, cauliflower, celery, cucumber, gourd, pumpkin and spinach.

Egyptian onions have lived and continued to present a good appearance but have not produced profitably. Chayote (*Sechium edule*) was introduced from Buitenzorg, and two plants grew vigorously. They flowered freely; and when no fruit set, 25 pistillate flowers were hand-pollinated. Even then no fruits set, and the plants died soon after it.

The strawberries were transplanted August 19th to a new bed which was fertilized January 3, with a mixture in the proportion of 53 parts of basic slag, 77 parts of kainit, and 21 parts of ammonium sulphate. Of this mixture, one kilo was applied to each 10 sq. m. of bed. The plants produced good berries from December to

February at which time they began to decline. They are now in good condition again. Berries were exhibited at the exposition.

Red Pepper.—Several varieties of Capsicum have been cultivated successfully. Among these are "sweet Spanish," "sweet square American," "monster," "long red" and "Cayenne," all from seed secured from Vilmorin-Andrieux. While all of these yielded satisfactorily, the last named was the best producer, yielding an average of 51 fruits per plant. The same plants fruited continuously from July 11th to April 12th, and were in good condition when removed to make room for other work. The "long red" yielded an average of 24 fruits per plant, but died before the end of the dry season. The same fertilizer mixture used on the strawberries was applied also to the "monster" peppers, but without evident results.

Several varieties of egg plant have been tested, the most satisfactory being *Violette ronde* (*Violette ronde trés grosse*). None of these, however, are equal to the egg plant produced by several years' selection by Mr. Kelleher of the Philippines Normal School.

Lettuce.—The best lettuce we have had is "Blonde géante." This was planted in boxes October 21st, transplanted November 4th. Half of the bed was fertilized with the mixture already described, and was again treated November 21st, with 1-10 kilo of sodium nitrate. The fertilized plants produced an average of 19 leaves in the solid head, while the unfertilized ones produced only 16 leaves. A full display was made at the exposition, and the remaining plants were allowed to flower, the seed being kept for future use.

Para Cress.—This plant has given uniformly very satisfactory results. For table use it is harvested when less than a month old.

Okra.—Okra continues to hold the place of the most reliable vegetable in our gardens. Germination is from 75% up. If the fruit is kept picked, the harvest can be prolonged for at least five months. From one bed of 25 plants, a large quantity of fruit was gathered and subsequently 3-5 of a kilo of cured seed was obtained.

FIBER PLANTS

Abacá.—Regarding fiber plants, but little is to be added to last year's report. The work on abacá has been chiefly in the preparation of the graduating thesis of Mr. Cevallos, already published. From his and other observations here, it is evident that in such a season as the past one has been, abacá will not thrive even tolerably here except when shaded or artificially supplied with water. It still seems true, however, that given sufficient water, abacá will grow in full sunshine with such speed and luxuriance as it never shows in shade.

Beside the local variety of abacá, we now have growing four of the most valued of the Davao varieties, the Tangungan, Maguindanao, Buñgalanon, and Libuton. All of these are growing in the nursery more rapidly than neighboring plants of the local variety. The Maguindanao and Buñgalanon are suckering most freely.

Agave.—*Agave fourcroydes* and *A. mexicana* are both growing in the nursery, but both progress surprisingly slowly.

Furcraea gigantea.—The Mauritius hemp was planted first along the south boundary of the farm. It was impossible to give it proper care there, and a number of plants were taken up and placed around the main building, where they are now growing satisfactorily.

Miscellaneous.—China grass continues to exhibit a very satisfactory growth. On water logged ground, it flowers without reaching a proper height, but under all conditions, except during extreme drought, it suckers freely and grows rapidly. It

is propagated satisfactorily both by seeds and suckers.

Imported seed of *Carludovica palmata*, the source of the raw material of Panama hats, refused to germinate; but a single plant secured from the Lamao Experiment Station has grown well and produced a number of suckers.

Material of *Cyperus tegetiformis* was furnished by the Director of the Bureau of Education. Due to delay in transmission and receipt, it arrived in very poor condition, and was slow in recuperating, but is now growing well in a small artificial marsh.

Cotton grown from American seed has flowered at a height of 60 cm. and produced bolls as freely as could be expected of plants of this size. It has been attacked by various pests, but not seriously injured by them. After fruiting once, several of the plants have remained alive and have produced two or three subsequent crops. Cotton seed obtained from Tarlac produced a perennial bush about 3 m. high, which has fruited most freely, and has been practically free from pests. The fiber is too tight to be of much value, but it should be possible to obtain a hybrid between this and the American cotton which should have the advantages of both parents.

Corchorus capsularis, jute, has been grown a number of times, but has always fruited before reaching such a height that the fiber could have been extracted with profit. *C. olitorius* is used as a source of fiber in some parts of the Philippines, and more or less plants are to be found everywhere.

Students of the College of Agriculture exhibited samples of the fiber extracted from banana, and pine-apple, and of coir at the Philippine Exposition, and were awarded prizes.

FRUIT TREES

Scattered over the farm of the college are more or less trees of a variety of fruits planted by the previous occupants of the land, or self-sown. Among these are *Sandoricum indicum* (santol), *Achras Sapota* (chico), *Lansium domesticum* (lanson), *Diospyros discolor* (mabolo), mango, tamarind, jak fruit (nanka), betel nut, and the local anonas. A definite orchard tract has been set off and the various fruits are being transplanted to this in groups as the material reaches a proper size. Beside this, a number of fruit trees have been scattered through the barrio occupied by the students, and a few have been planted in other places for their landscape gardening effect.

ANONA.—There are also new plants of five species of *Anona*, *A. reticulata* (Anonas), *A. squamosa* (atis), *A. muricata* (guanabano), *A. cherimolia*, and *A. glabra*. The cherimoya has proven hard to handle here, and success can only be looked for at altitudes above that of the farm. A considerable number of plants of *Anona glabra* have been set out with the expection of using most of them as root stocks for cherimoya or other species. There are young seedlings grown from both imported and native seed of the other three species, and all are growing well.

GUAVA.—Beside the native guava, there are young plants from imported seed of *Psidium aromaticum*, *P. chinense*, *P. cattleyanum*, and *P. guayava*, varieties *pyriferum* and *pomiferum*. These have all been transplanted to the orchard, and are growing satisfactorily.

CITRUS.—The lemons grown from seed obtained at the preceding Carnival from fruit grown in Negros, but originally from California stock, are growing, but develop very slowly. Aside from a few trees of the native orange growing before the establishment of the college, the other citrus plants are still in the beds. Among these is a wild native lemon from the forest back of the college, which, aside from being a most promising root stock, offers promise of development for its own fruit.

PAPAYAS.—Trees grown from conspicuously fine fruit found in the Zamboanga market are now in bearing. The fruit is very long and heavy, with remarkably thick flesh, fine flavor and few seed. The tree is monoecious and seems to hold its characters well here. Of the several varieties of which seed was received from the Federal Experiment Station in Honolulu, the Ceylon Round has proven most satisfactory. Under poor conditions, because planted on ground previously in grass, the average number of fruits has been 17, average height to the fruit 1.14 meters, and to top of stem 2.3 meters. A majority of the plants are female and the flavor is excellent. The Ceylon Long gave a somewhat larger percentage of female plants, but, under the treatment it received, did not bear as well.

MISCELLANEOUS. A considerable number of varieties of banana have now been accumulated, and the material is sufficient to demand the establishment of a banana plantation. The varieties in the nursery are buñgulan, butuan, sabá, tundok, lakatan, morado, Bluefields, and dwarf Hawaiian. The pitogo and Hawaiian were fertilized and watered during the dry weather and produced appreciably larger fruit as a result.

The attempt to keep the silk house in full operation resulted in too close cropping of the mulberry field, which suffered further as a result of drought and typhoons. Only enough worms are now being raised to insure the maintenance of the strain, and the mulberries are coming into good condition again.

Among the miscellaneous trees in the nursery and students' barrio are *Adansonia digitata, Eugenia jambosa, Kigelia pinnata, Machaerium Tipa, Spondias lutea, Coccoloba uvifera, Mammea americana, and Pangium edule.* The last is from seed obtained in the forest near Zamboanga, and is now growing well on the river bank here.

RUBBER

The last report showed that *Hevea braziliensis, Manihot dichotoma* and *M. piauhyensis* had been set out as a plantation. The labor was insufficient to maintain these in proper condition, and as a result the growth has been slow and a number of trees died. The vacancies were filled in January and February and the field has now been put in decent order. A considerable number of seedlings of these species were turned over to the Department of Forestry, and planted with various other seedling trees on the hill above the students' barrio. Seed of *Manihot heptaphylla* showed poor power of germination yielding only 8.29% of seedlings. These are now ready to transplant.

The twenty-eight trees of *Castilloa* planted opposite the laboratory are not in such ground as this plant is supposed to demand, but nevertheless are growing very well. Seed from these trees has been planted in the nursery showing at best a germination of 50%.

Twenty-five plants of *Mimusops Balata* from seed obtained from Vilmorin-Andrieux and Co. have recently been transplanted and are growing well.

Cryptostegia madagascariensis has shown an excellent germination of 90% and proven itself very hardy and a quick grower. A considerable number have been planted in the students' barrio and elsewhere on the farm.

Marsdenia verrucosa has proven a phenomenally rapid grower, and from present indications should be regarded as offering real promise in cultivation here.

GUTTA PERCHA.—By the courtesy of the Director of the Buitenzorg garden, we have received five plants each of *Palaquium oblongifolium, P. Treubii,* and *Payena Leerii.* These are still in the nursery where they are growing slowly.

MISCELLANEOUS

MEDICINAL PLANTS.—Seed of *Strychnos Ignatii* (the St. Ignatius bean) has been

obtained from the Samar exhibit at the last two Carnivals. In both cases the germination has been slow, ranging from 23 days to more than three months. The early growth has been satisfactory, but was followed by a period of stagnation. The plants one year old are now almost as large as those a year older.

The history of the growth of *Strychnos Nux-vomica* is somewhat the same. Germination took thirty-five days. After the initial spell of vigorous growth, there was but little further progress for almost a year. During this time, the shoots or branches formed were all curved backward and kept the aspect of lateral branches. The plants have recently begun to develop very vigorously, putting up a rigid erect shoot of fairly rapid growth with horizontal remarkably rigid branches, of quick but abruptly limited growth.

Two trees of *Aleurites trisperma*, from seed obtained in the spring of 1910 from Maragondon, Cavite, suffered from mechanical injuries during the first year and a half, but are now growing very rapidly and developing as robust trees.

From two plants of *Erythroxylon Coca* (cocaine) obtained during the first year of the college, a considerable number of seed have been obtained. This germinated well, but the seedlings stand transplanting badly. The delicate light green foliage is so attractive that the plant is worth growing as an ornamental, altogether aside from its possible utility as a source of cocaine.

Other possible sources of drugs being tested are *Sapindus saponaria, Copaifera officinalis, Jatropha Curcas,* and *Cinnamomum Camphora.*

Decorative Plants.—Mr. Cuzner's students in Landscape Horticulture have planted a large number of small ornamentals along the main road of the college grounds. Among these are various varieties of *Codiaeum, Caesalpinia pulcherrima, Barleria cristata, Gardenia, Jasminum Sambac, Acalypha, Hibiscus Rosa-Sinensis,* and scattering plants of other kinds.

Beside the nursery ditch, a small marsh has been created in which are *Acrostichum aureum, Nelumbium speciosum, Cyperus revoluta, Typha angustifolia,* and several aroids. On a dry point near this marsh, several conspicuously xerophytic cacti and Euphorbias are grouped.

A number of the ornamentals in the nursery have grown until they take up more room than can well be afforded there. Among these are *Passiflora quadrangularis Bougainvillea, Belamcanda, Enterolobium,* Bauhinias of doubtful specific identity, *Musa coccinia, Leptosolena Haenkei, Hedychium coronarium,* and *Bignonia magnifica.* The last named seems secure in its place, as the finest of all our ornamentals. *Leptosolena,* a native of the Benguet high land, has proven a most vigorous and ornamental lawn plant.

For decorative purposes, flowering herbs have an insignificant place here compared with that in the temperate zones. Not many of these have been tried by the college, and of those tested, none but the tuberose, *Polyanthes tuberosa,* has grown and flowered as freely here as it would be expected to do in temperate countries. Some others, such as *Dahlia,* will grow and blossom, but without making a display which could be regarded as at all a success.

In the place of flowering herbs reliance is to be placed here on foliage plants and on flowering shrubs and vines. Some of the latter, such as Hibiscus, Barleria, Passiflora, Bongainvillea and Bignonia, have already been mentioned. Among other valuable vines, as demonstrated in our nursery, are *Clitoria, Lonicera, Porania volubilis,* and several of the legumes like *Tetragonolobus* whih at the same time produce food. Among the foliage herbs *Coleus* and *Alternanthera* are exceedingly thrifty, but the first place must be given to the varieties of the Bra-

zilian plant known as *Caladium bicolor*. There are tenor fifteen fine varieties this plant grown in the Philippines which we have seven in the nursery. Beside these, forty-nine varieties were obtained from Vilmorin-Andrieux of which nearly all germinated and are growing satisfactorily. The college has accordingly an excellent display of these valuable ornamentals. For work on a small scale, the varieties or species of *Calathea* are also very valuable. We have at present six of these. Our most valuable hedge plant, if kept well trimmed, is *Barleria cristata*, but if not well attended to, it becomes coarse and ragged. *Duranta repens* is subject to the same objection. Under such conditions, *Galphimia glauca*, which is of slower growth and flowers exceedingly freely, is our best material for dense borders. Along roads in this neighborhood, a very gay and pleasing effect is produced by the dense planting of *Cordyline terminalis*. Various species and varieties of *Hibiscus*, *Panax*, and *Graptophyllum* are used in the same way.

We are using a number of the plants last mentioned for open park planting, and a number of species of Bauhinia have also proven valuable for this use. Larger plants used on the farm in the same way, beside those coming into fairly general use along Manila streets, are *Cecropia peltata*, *Schizolobium excelsum*, *Kleinhovia hospita*, and a number of palms. Among the palms, *Arenga mindorensis*, a recently described species which is reasonably abundant in the gorge of the creek, is especially attractive. There is often so great a difference between the promise of a small tree and the realization when the tree matures, that it is not worth while to report at length on the various young plants which we hope will later prove valuable additions to the horticultural wealth of the islands.

HACIENDA ZAMORA

Trebles results by up to date methods

José Zamora, one of the first graduates of the college of agriculture of the government university, is in Manila on business. Mr. Zamora has charge of his father's hacienda in Tarlac, known as the Zamora hacienda.

He reports that everything is in pretty good shape in Tarlac and that the people are on the whole prosperous. He is doing pioneer work in that province, going around among the people and telling all about the proper method of rice cultivation and instructing the rice growers in the scientific eradication of rice enemies.

He told a TIMES reporter, "Yes, I have charge of a hacienda containing 450 hectares, and I feel that my success is due largely to the college of agriculture. Already I am harvesting my third rice crop this year, due perhaps to the more advanced and exact methods which I am using. Three years ago we used to get only one third of what we are now raising, which goes to prove what practical, scientific farming can do here."

(From *The Manila Times*, Oct. 23, 1912.)

The real test of the efficiency of the college is the work done by its graduates. José Zamora was one of the three members of the first class. In June, 1911, following his graduation in April, he took charge of his father's hacienda of 450 hectares, in the province of Tarlac. This was no nominal charge, for his father has

TRANSPLANTING RICE ON THE HACIENDA ZAMORA.

since been living out of the Islands. The hacienda is that used by the Government a number of years ago for the demonstration of model rice culture. The demonstration was that model rice culture did not pay. After the Government gave it up, the hacienda went backward in the hands of tenants.

During the past year, Mr. Zamora built a house for himself, and a sugar mill, and built a number of new dams and put the irrigation system in order. At the same time, he has brought land into cultivation in rice, sugar, and maize, has overseen and improved the work of the tenants with the results stated above, and has introduced a variety of special cultures, including a lemon orchard. The following notes and photographs give an idea of successful farming in the Philippines.

During the first year, he devoted most of his time to rice. He had sixteen carabao, and with these he put thirty-two hectares into paddy rice. The total area of paddy rice on the farm is 350 hectares, the larger part being in the hands of his tenants. Because of the general

THRESHER AT WORK.

PLANTING SUGAR CANE.

drought, the crop was a poor one amounting to only thirty-five cavanes.*

In 1912, using the same number of carabaos he increased his paddy rice to sixty hectares, and at the same time planted twelve hectares of upland rice and ten hectares of sugar cane. As threshing has just begun, the yield of this crop cannot be stated, but is expected to reach a total of seven or eight thousand cavans.

* This is the usual way of measuring a rice crop in the Philippines. The cavan is a measure of volume, or secondarily of weight; it is also the area of land planted with one cavan, and in this sense is usually a little less than one hectare. The statement above means that from one cavan of land the harvest was thirty-five cavans of rice in the hull; in other words, that the crop was thirty-five fold.

Lowland rice in Tarlac is planted in seed beds in June, and transplanted in July. Transplanting is done by men, women, and children indiscriminately, at the rate of twenty-five centavos a day. The harvest is in November and December. Threshing was formerly by carabao; but Mr. Zamora has bought a nineteen horse-power thresher, with a capacity of 180 to 250 cavans a day. It cost ₱6300, and, threshing the rice of the neighbors, pays a profit above expenses of twenty to thirty pesos a day. A larger machine would pay better returns.

Work with sugar cane began in January, 1912, and it is Mr. Zamora's intention

SUGAR CANE ON THE HACIENDA ZAMORA.

SUGAR MILL, HACIENDA ZAMORA.

ultimately to plant a considerable part of the farm with this crop. The mill which has been built cost ₱4000, and has a capacity of 2500 to 2750 gallons a day of ten hours. Sugar cane is planted in Tarlac from December to March. The labor of getting the cuttings from the field is paid by the number of cuttings secured, the usual price being ₱1.00 for ten thousand. The cuttings are taken by the tenants or laborers, and soaked in water for two or three days. They are then covered with straw and left for two or three days more for germination, and are then ready to be planted in the field. The furrows are drawn from ninety centimeters to one meter apart, and if the planting is early the cuttings are placed from seventy to ninety centimeters apart in the furrows. If the planting is as late as March or April, the cuttings are placed forty to fifty centimeters apart. The planting is done by women who are paid ₱1.00 per thousand.

The first cultivation is when the height is twenty to twenty-five centimeters. At this time the harrow is passed over the plants. The next cultivation is after four or five months when the cane is well grown. The cane is ready for milling when nine to twelve months old.

SUGAR ROLLER, HACIENDA ZAMORA.

During the harvest, two sets of men work in connection with each furnace. Outside the mill are two men to cut the cane, one to carry it to the mill, and two to feed it between the rollers. Inside the mill are three men occupied with the making of the sugar. This work is all paid by the job, the payment being based on the production of juice. For each 200 gallons, there is paid fifteen centavos for the cutting, fifteen centavos for hauling to the mill, and fifteen centavos for feeding it between the rollers, and forty-five to fifty centavos for the work within the mill. The engineer is paid ₱25 or ₱30 a month, and the fireman ₱12 a month. From 200 gallons of good juice, two and a half piculs of sugar is produced. The well crystallized sugar is marketed in bayones, and that not well crystallized, in pilones.

MAIZE IN THE FIELD. HACIENDA ZAMORA.

The corn crop during 1912 was most satisfactory, the stalks reaching a height of more than 3.5 meters.

From this crop a selection was made of the seed which will be next planted. The rows are 80 centimeters apart and the seeds 60 to 70 centimeters apart in the row.

COURSE IN EXPERIMENTAL PLANT PHYSIOLOGY

The most essential peculiarity of the course in agriculture given in this college is its foundation in plant physiology. In other agricultural colleges, it is the almost universal practice to find the foundation for scientific agriculture in chemistry rather than in botany. The reasons for this are historical. Chemistry developed earlier than plant physiology to the point where it could furnish such a foundation. And agriculture as a science was founded by chemists. Since the men who gave its character to modern agriculture—von Liebig and his school more than any others—were chemists, it was only natural that chemistry should have a foremost place in agricultural colleges.

Chemistry will of course always retain a place, and a very important one, in agricultural science. But, speaking now of plant industry only, the reasons for giving the foremost place to chemistry have ceased to be practical or valid. Plant physiology has long since grown to the point where it furnishes a more complete material for the understanding of most agricultural problems, and a better basis for most agricultural practice. In a profession which depends for its success on the behavior of plants, it is too evident to need any argument that the best educational equipment must be an understanding as complete as possible of the behavior of plants, and of the means of controlling their behavior.

Moreover, an educated, practical farmer can practice plant physiology on the farm, and should do so with profit. But I do not believe that one per cent of the graduates of agricultural colleges, well trained as they usually are in chemistry, apply in farm practice more of it than they could do after a single year of well directed study of the subject. More than a year of chemistry has an indirect rather than a direct value. Last year, I asked a series of questions of a number of students in the senior class of one of the foremost American agricultural colleges. The replies were essentially the same in every case; that they studied agriculture in college in order to understand it as a science; that as they had studied agriculture chemistry furnished its scientific basis, and that they did not expect to be able to make direct use of what they had learned in this science. To the final question, as to whether they would have been able to make better use of their scientific training if it had been in plant physiology rather than chiefly in chemistry, some answered that they would, and others, who had had no plant physiology, that they did not know.

I have no doubt that the coming decade will see a pronounced turning toward plant physiology in the agricultural colleges of English speaking lands. It makes little difference in practice whether this movement be at first an avowed one, or whether a prominent part be taken by chemists who, like Adolph Mayer, will give the foremost place in their agricultural chemistry to what is really the physiology of plants; or even by so-called physicists of Wollny's school. In the tropics the necessity of giving this direction to agricultural training is even clearer than in temperate lands. For tropical agriculture, so far as the commercial products are concerned, is practically synonymous with plant industry; and the local food is vegetable in far larger proportion than in temperate lands.

In this college, two years of botany precede all work with crops. And during the succeeding years, while the crops themselves are being studied, their physiology receives constant attention in both class room and field. During the first year of the college, it was necessary for

practical reasons to focus attention, to an extent which would not be permanently proper, upon the growth of the crops. Such work has a practical value which many people seem not to realize at all. The most direct and most easily read index of the condition of any plant or field of plants is furnished by its rate of growth. We have carried the study of the growth of certain crops far enough so that we believe that with at most a few days' observation, we can forecast with a high measure of confidence the future production; and that in the case of perennial crops, this forecast may extend over a number of years. We have more complete information as to the normal rate of growth of these plants, and as to the control of this rate, than has been published regarding the growth of any crops of temperate regions. This work has only been well begun as yet, and we hope to see it continue, and expect to see it continue with practical advantage, for a considerable number of years. Some idea of what has been done already may be gathered from the fact that we have records of more than three hundred thousand single determinations of rates of growth.

The other phase of vegetable physiology which demands a most important place in preparation for agricultural work is nutrition. We are this year (1912-1913) giving what may be regarded as proper attention to the simplest and most fundamental part of this subject,—the transpiration of plants. And with the establishment of a well equipped chemical laboratory, it has now become possible to give all due attention to the whole field of plant nutrition.

In view of the general absence of such courses in agricultural colleges, an outline of the experimental work of our course may well be of interest. The course as given in the following pages is that actually in use here this year. We find in practice that the students can do somewhat more work than this during the year, and accordingly expect to add some experiments on nutrition. There is only one experiment, that on the determination of the sex of the papaya, which cannot be completed during the school year, and in this case, students are expected to make their final observations during the year following. The students taking this course have lectures three hours a week, but there are many experiments which cannot be performed in scheduled hours, and in such cases students of course give them all necessary attention.

OUTLINE OF EXPERIMENTS

A. Physical properties of organized substance.
B. Transpiration.
C. Mineral Food and Nitrogen.
D. Photosynthesis.
E. Respiration.
F. Growth.
G. Directive stimuli.
H. Reproduction.

A

1. Imbibition by wood.
2. Imbibition by starch.
3. Imbibition by seeds.
4. Evolution of heat during imbibition.
5. Conduction of heat.
6. Diffusion of gas through cuticle.
7. Osmometer.
8. Plasmolysis.

B

1. Absorption by roots, measured by weighing.
2. Absorption, measured by movement of bubble.
3. Absorption, measured volumetrically.
4. Wilting due to dryness of soil.
5. Wilting due to concentration of solution.

6. Path of transpiration stream—ringing.
7. Path and rate of transpiration stream—eosin.
8. Root pressure.
9. Bleeding.
10. Guttation.
11. Suction by cut branch.
12. Absorption by cut branch.
13. Transpiration measured by direct weighing.
14. Transpiration measured by transpiration machine.
15. Transpiration measured by collecting transpired water.
16. Cobalt test of transpiration.
17. Effect of light on transpiration.
18. Effect of heat on transpiration.
19. Effect of moisture on transpiration.
20. Effect of wind on transpiration.
21. Movements of stomata.

C

1. Set of water cultures.
2. Fertilizers on plots.
3. Stimulants.

D

1. Recognition of starch, gross.
2. Microscopic demonstration of starch.
3. Need of carbon dioxide.
4. Need of light.
5. Evolution of oxygen.
6. Gas analysis.
7. Demonstration of carbohydrates.

E

1. Loss of dry weight in germination and growth in darkness.
2. Evolution of carbon dioxide.
3. Evolution of heat.

F

1. Growing region of stems.
2. Rate of growth of stem of erect dicots.
3. Rate of growth of shoot of monocots.
4. Rate of growth of vines.
5. Influence of light on growth.
6. Etiolation.
7. Influence of soil water on growth.
8. Influence of humidity of air.
9. Influence of temperature on growth.
10. Growth in different habitats.
11. Growth by day and night.
12. Growth of seedlings.
13. Measurement with auxanometer.
14. Measurement with kathetometer.
15. Growth of different axes.
16. Growth of leaves.
17. Growth of aerial roots.
18. Growth of primary root.
19. Growth of roots of old plants.

G

1. Geotropism of stems.
2. Geotropism of roots.
3. Centrifugal force.
4. Heliotropism of stems.
5. Heliotropism of Pilobolus.
6. Heliotropism of leaves.
7. Hydrotropism in air.
8. Hydrotropism in soil.

H

1. Prevention of pollination.
2. Cross pollination.
3. Sex of Carica.

Those under the headings F, G, and H are expected to be performed by the individual students. The remainder will be performed by the students in groups of four. It is not expected that the experiments shall be performed in the order here given, as a part of them must run over considerable lengths of time.

In reporting these experiments, use one page for each experiment; if necessary use more than one, but the experiments should, in general, be made according to the following form:

1. Object of experiment.
2. Materials used, including the Latin name of the plant.

3. Description of the method.

4. Results. Tabulate whenever possible.

5. Conclusions. Draw conclusions fully and carefully, omitting no part of the evidence or argument.

DIRECTIONS FOR EXPERIMENTS

A

1. Cut and weigh blocks of wood of known kinds, small enough so that they can be measured with the micrometer caliper, having the sides plane and with one side radial, one tangential, and one transverse. Dry these cubes as completely as possible, and weigh. Measure exactly the three sides mentioned. Immerse in water and measure the swelling at hourly intervals for six hours, and thereafter daily while swelling continues. Tabulate the results showing the measurements made and the percentage of increase in each direction. Weigh at close of experiment, and determine relation between increase of volume and increase of weight.

2. Use dry starch of a known kind. By means of a stage micrometer, measure the units of the eye-piece micrometer. Mount the starch dry and by means of the eye-piece micrometer measure two axes of large grains. Let water run under the cover glass, and measure the increase in these diameters at intervals of thirty seconds while swelling continues. In tabulating the results use the actual measurements and the percent of increase finally reached. The table should cover observations from five grains.

3. Use seed of a known kind and weigh accurately having as nearly 10 grams in each lot as is practicable. Measure three axes of three marked seeds with the micrometer caliper. Immerse one lot in water at the temperature of the room; one lot in water as near the freezing point as possible; one lot in a 5.7% solution of common salt, and one lot in water at a fixed temperature between 40 and 60 degrees. The temperature in all cases must be exactly known. Start all lots at once and weigh five times at intervals of two hours. Measure the marked seeds at the end of the experiment. Tabulate all results showing the observations made and the increments in percentage.

4. Use 20 grams of perfectly dry starch with an equal weight of water, being sure that the water and starch have the same temperature. Mix as suddenly and completely as possible, and watch and record the temperature of the mixture. Repeat using 10 grams of water.

5. Take blocks of wood such as were used in Experiment A-1. Coat the faces with a thin layer of paraffin. Into the middle of each face stick a hot needle penetrating well into the wood. Measure the areas melted and explain.

6. Use glass tubing 3-6 mm. inside diameter and about 20 cm. long. Fit one end into a cork, and immerse this end with the cork in hot paraffin. Onto the upper side, seal a piece of a leaf which has the stomata confined to one side, leaving exposed the side without stomata. Coat this surface with paraffin except for 1 sq. cm. over the hole in the cork. Fill the tube with carbon dioxide over a mercury bath. Record the rise of the mercury in the tube and explain.

7. Soak a porous cup or shell in a strong solution of copper chloride or sulphate. Remove from this solution and fill with a solution of 1% potassium ferrocyanide, and 5% cane sugar. Insert tightly a rubber stopper with one hole in which is a long and slender glass tube. Set up in a solution of 1-5% copper chloride and observe the rise of the liquid in the tube. This experiment may be made with a thistle tube having parchment paper tied and sealed over the end, instead of the porous cup.

8. Prepare a normal solution of potassium nitrate. From this make solutions

of 0.15 normal, 0.2 normal, 0.25 normal, 0.3 normal, 0.35 normal, 0.4 normal, and 0.5 normal. Immerse trichomes of any local Commelinaceae or Cucurbitaceae in small vessels of these solutions. After 15 minutes determine which concentration is just sufficient to cause plasmolysis to begin. Make the same experiment with sections of leaves. All materials used must be determined.

B

1. Place a small plant with healthy roots in a bottle of water, fitting it into the cork with cotton which does not touch the water. Weigh the bottle and plant at intervals of two hours through one day.

2. Atmometer. Use the same kind of apparatus but put a glass tube through a hole in the cork and bend the tube so that its long arm is horizontal. Seal the cork air-tight; determine what length of the horizontal glass tube contains 1 cu. cm. of water, and graduate it accordingly. Measure the rate of absorption by the movement of bubbles in this tube.

3. Arrange the experiment as in B-1, but use graduated cylinders and measure the absorption of water volumetrically.

4. Use plants grown in pots. Prevent the loss of water except by transpiration. Weigh daily, determining the loss of weight, and keep a record of the condition of the plant. When it becomes well wilted, determine the percent of water in the soil.

5. Arrange the experiment as B-1, but have several plants as alike as possible. Determine what concentration of saltpeter or common salt applied to the roots will cause the plant to wilt.

6. Use a shrub where found out of doors. Remove a ring 1 cm. in length cutting to the cambium and no deeper. Using a similar branch of the same shrub, remove the tissues inside the cambium without cutting the outer tissues except longitudinally. It will be necessary to support the upper part of this branch. Watch the effect on the part of the branches above the cut, and explain.

7. Cut off a branch with a clean cut with a sharp knife, making the cut under water. Let it stand with the cut surface in water for ten minutes. Insert the cut surface in a solution of eosin taking care that the cut surface does not, at any time, come in contact with the air. After three minutes remove from the eosin and instantly cut the branch into sections 5 cm. long. Examine the cut surfaces with a lens and draw full conclusions.

8. Cut a stem off at a convenient distance above the ground, and make a tight connection between the cut end of the remaining stem and a U-tube containing mercury. Measure the pressure by the difference in the height of the mercury columns. Determine the daily variation in this pressure if there is any. It may be necessary to try this experiment several times in order to secure a suitable subject.

9. Treat a stem as in B-6, but measure the amount of water given off instead of the pressure.

10. Selecting a plant which you know to excrete water from the leaves, collect this water and determine the amount of it by night and by day. This experiment should be worked in the open and rain must not interfere with it.

11. Cut a branch under water with the precautions directed under B-7. Make a tight connection, by means of a short, heavy rubber tube, between the branch and a glass tube of small bore a meter in length. Fill this tube nearly full of mercury, and place the free end in a mercury bath. Clamping the cut branch tightly in place, determine the difference in level between the mercury in the bath and in the tube when absorption is no longer possible.

12. Experiment as in B-1 using a cut branch instead of a plant with roots. Use precautions as in B-7.

13. Arrange experiment as in B-4 so that a plant with its pot can lose water by transpiration only. Determine, by weighing, the loss of weight at intervals of two hours during one day, and at intervals of a day for a week. If it is practicable to use the same plant for B-2 and B-11, this may be done.

14. Make a record during twenty-four hours of the loss in weight of a leguminous plant and of some other plant by means of the transpiration machine. Directions for the use of this machine will be furnished by the laboratory assistant.

15. Place a plant under a bell jar in such a way that no air can enter the jar except through one tube and that none can leave it except through another tube. Connect each of these tubes with a tube or tower of calcium chloride which must be thoroughly dried. By means of an aspirator, draw air through the entire apparatus at the rate of five liters an hour. Determine the transpiration by the increase in weight of the calcium chloride through which air passes after leaving the plant.

16. Soak filter paper and blotting paper of uniform weight in a solution of chloride of cobalt. Dry the paper until further drying will change its color. Cut out and weigh a piece of known size and place another piece at the same time in a bottle and seal the bottle. Dry the measured piece until it is distinctly red or pink. Weigh quickly and place in another bottle and seal. From the increase in weight with the change in color, calculate the amount of water absorbed by each kind of paper during the change from one of the standard colors preserved in the bottle to the other, for each square centimeter of paper. Taking care to begin each test with color of exactly the shade of the blue standard, determine the rate of transpiration from each surface of leaves of three different kinds, using each kind of paper on each plant. To guard against absorption of moisture from the air, the paper should be held against the leaf by means of glass, and in experiments lasting more than a few minutes, the air should be prevented from penetrating under the glass by means of vasoline.

17. By either of the three methods experimented with in B-11 to B-13, determine the effect on transpiration of (a) darkness, (b) the diffuse light of the laboratory, (c) the light of the open sky without direct sunshine, and (d) of direct sunshine.

18. Experiment as in B-17, determining the relative transpiration at (a) temperature of the laboratory, (b) temperature near the freezing point, and (c) temperature of approximately 35 degrees. Determine the temperature of air and leaves, in B-17.

19. Experiment as in B-17 determining the relative transpiration (a) in the atmosphere of the room, (b) in an atmosphere nearly saturated with vapor of water, and (c) in an atmosphere practically without water.

20. Experiment as B-17 determining the relative transpiration in (a) perfectly still air, (b) in a light breeze, (c) in a strong current of air. Determine with the anemometer the velocity of the air in this experiment.

N.—B. In experiments B-17 to B-20, the utmost care must be taken that no external conditions vary at all except the ones on which the several experiments are made. If these conditions can be perfectly met, there is no objection to making experiments B-17 to B-20 in connection with experiments B-13 to B-15; but separate reports are to be submitted.

21. Using preferably a plant with large stomata, cut a surface section such that the stoma can be observed easily under the microscope and in which the stoma is open in water and full illumination. Measure with the eye-piece micrometer the width of the pore and of the entire stoma.

Cut the light off completely for ten minutes, and measure again. Measure a third time after ten minutes in the light. During this experiment, care must be taken that the preparation does not dry out. Run 0.5 normal potassium nitrate under the cover glass and measure as before. Replace this with water and measure a fifth time.

C.

1. Water cultures. The standard water cultures solution to be used is:

Potassium nitrate,.....	0.0025 N.
Magnesium sulphate.....	0.0025 N.
Potassium phosphate.....	0.0025 N.
Calcium nitrate.....	0.0050 N.
Iron.....	a trace.

As subjects, use maize, Psophocarpus tetragonolobus, and Corchorus capsularis. Make two cultures of each plant in the standard solution. For each plant, make other cultures as follows:

III. Substitute potassium chloride for potassium nitrate and calcium sulphate for calcium nitrate. (Nitrogen free).

IV. Substitute sodium nitrate for potassium nitrate, and sodium phosphate for potassium phosphate. (Potassium free.)

V. Substitute sodium sulphate for magnesium sulphate. (Magnesium free.)

VI. Substitute two parts of potassium chloride for potassium phosphate. (Phosphorus free.)

VII. Substitute magnesium chloride for magnesium sulphate. (Sulphur free.)

VIII. Substitute two parts of sodium nitrate for calcium nitrate. (Calcium free).

IX. Use the normal solution without iron. (Iron free.)

In all cases keep the roots in darkness.

Keep a record of the growth of stem or tallest leaf, and length of longest root, and of the amount of water transpired. When any plants die, find the dry weight. Compare results with ash analysis of the seed. Tabulate the results and draw conclusions as to the relation of each of the seven food elements tested, to growth, to the increase in dry weight, and to the transpiration.

2. Conduct this experiment in open plots each of which should be 10 meters long and 2 meters wide. On each plot one linear meter should be planted to each of the following plants in this order:

1st, Dolichos Lablab,
2nd, Phaseolus vulgaris,
3rd, Zea Mais,
4th, Lactuca sativa,
5th, Ipomoea Batatas
6th, Raphanus sativus,
7th, Hibiscus Sabdariffa,
8th, Hibiscus esculentus,
9th, Solanum Melongena,
10th, Lycopersicum esculentum.

There should be ten plots, treated as follows:

1st, Control (without fertilizer).
2nd, 500 grams ammonium nitrate,
3rd, 500 grams potassium chloride, or potassium sulphate
4th, 500 grams sodium phosphate, dehydrated,
5th, 500 grams potassium nitrate,
6th, 500 grams potassium phosphate,
7th, 500 grams each potassium nitrate, potassium phosphate,
8th, 500 grams each potassium nitrate, potassium phosphate, and calcium oxide,
9th, 10 kilograms of chicken manures
10th, Control.

Keep weekly record of growth and production of all plants of one kind.

(These directions fit a class of forty students, working in groups of four. Each group has the plants of one kind, which are in rows extending across all the plots. A larger class will make longer plots).

3. Conduct this experiment in pots, each containing one kilogram of clean garden soil. This soil must be uniform for all pots. Plants and applications are as follows:

Pots I-III, radish without stimulant,
" IV, radish with 0.001 gram potassium iodide,
" V, radish with 0.005 gram potassium iodide,
" VI, radish with 0.01 gram potassium iodide,
" VII-IX radish with the same amounts of potassium fluoride,
" X-XII rice without stimulant,
" XIII-XVI rice treated with manganese sulphate, 0.5 gm., 0.2 gm., 0.05 gm., and 0.01 gm. respectively,
" XVII-XX rice with iron sulphate in the same quantities.

Keep weekly record of the growth of all plants and of the water put on the pots.

D.

1. Using any plant with reasonably large leaves, keep a leaf in total darkness during two days. Then, beginning in the morning, cover the leaf with a piece of tin foil or opaque paper through which your initials have been cut. Expose to full sunshine during the day. Remove the leaf, dip it for a moment in boiling water, and then remove the chlorophyll by soaking in alcohol. Immerse the decolorized leaf in an alcoholic solution of iodine and observe the result.

2. Cut sections of a leaf which has been in direct sunshine, decolorize in alcohol, treat with iodine solution, and examine under the microscope. Compare with sections of a leaf which has been in darkness.

3. Place small plants, or vigorous shoots in water, under two bell jars. In one bell jar, place an open dish containing caustic alkali. Expose to direct sunshine for a few hours, and examine for starch. Before beginning this experiment the subjects of it should be kept out of direct sunshine for two days.

4. From experiment D-1, explain the relation of light to the formation of starch.

5. Place a quantity of Ceratophyllum or other submerged plant in water in a glass jar. Place in full sunshine and, by means of an inverted funnel and test-tube, collect the gas which is given off. Test this gas for oxygen. Repeat the experiment placing the plant in boiled water over which is a very thin layer of oil. Compare the result with that of D-3.

6. Take three barometer tubes or eudiometers, calibrated to read volumes from the top. In each fasten near the top a leaf. Fill the tubes with gas-free water. Invert over a mercury bath and displace the water with air which has passed through a baryta solution. Draw the mercury up a few centimeters into the tube, leaving a very thin film of water above it. Read the volume of air in the tube making a record at the same time of the temperature, atmospheric pressure, and height of mercury in the tube. Introduce into two of the tubes a few c. c. of carbon dioxide, and again take the necessary readings for determining the amount of gas. Enclose one tube containing carbon dioxide with an opaque jacket or cover. Expose the tubes as arranged to bright diffuse light for four hours. At the end of this time, bring into the laboratory and after fifteen minutes read again the volume of gas, temperature, atmospheric pressure and height of mercury as before. Introduce into each tube a little concentrated caustic potash. Wait a few minutes and take readings as before. Determine the volume of the leaf and anything used to hold it in place in each tube. Determine the amount of gas actually present at each time observations were made, making allowance for the volume of the leaf and the water

vapor present, and reducing the other gases to 760 mm. barometric pressure and zero temperature. Calculate the evolution or consumption of carbon dioxide and oxygen, assuming that other atmospheric gases were constant.

7. Prepare sections of each leaf at the close of experiment D-6. Place these sections for a short time in a concentrated solution of copper sulphate. Wash them in water and dip them into a boiling solution of 10 grams of caustic potash and 10 grams of sodium and potassium acetate in 10 grams of water. Examine under the microscope for the red precipitate of cuprous oxide which will appear in the cells containing glucose. Examine other sections of the same leaves for starch by removing the chlorophyll and staining with iodine.

(After this year, an experiment will be added here as. D-8. Like E-1, except that the seedlings grow in light.)

E.

1. Determine the percentage of moisture in about 10 grams of some kind of seed. From this determination, calculate the dry weight of five other lots of seed of about 5 grams each. Germinate these five lots and at intervals of one week, determine the dry weight of the seedlings, one lot at each time. Keep the seeds and the seedlings in darkness. Keep a record of growth during this experiment.

2. Normal and intra-molecular respiration. Use as material 100 or 200 grams of germinated seed of any convenient kind which is not too large. This should be placed in a bottle through which air can be drawn, and which should also contain a thermometer. To maintain a constant temperature this bottle should be immersed in water and air should be drawn to it through a coil immersed in the same water. Before reaching this tube, the air is drawn through a potash tower, and a U-tube or bottle containing baryta water. After leaving the seeds, the air goes to a Pettenkoffer tube which contains a measured amount of baryta water of known alkalinity. The air is drawn through this baryta water in small and uniform bubbles. It then passes through a small bottle of baryta water to a large aspirator by means of which a stream of air can be drawn through the entire apparatus at a rate subject to accurate control. The apparatus just described is suitable for the measurement of normal respiration. The experiments should run for at least four hours with hourly change of the Pettenkoffer tube, and determination by titration of the carbon dioxide evolved during each hour.

For intra-molecular respiration, the apparatus is the same except that pure hydrogen is drawn through the apparatus instead of ordinary air. The entire apparatus should be set up in duplicate using the same kind of materials after determining the rate of normal respiration of both cultures, draw air through one and clean hydrogen through the other.

3. Evolution of heat in respiration. Fill three Dewar flasks with germinating seed such as were used in the preceding experiment. Close one tightly leaving ordinary air inside. In one replace the air with oxygen, and in the third, replace it with hydrogen. In a fourth flask, put similar seed which have just been killed and sterilized by thorough boiling, and leave air. Keep the record of the temperature in the four flasks.

F.

1. The younger part of the stem is to be ruled with India ink into exactly equal zones, the first mark being spaced at the unit of distance back of the tip of the youngest visible leaf. The marks should be short with the exception of each fifth one, which should be longer than the others, and each tenth one, which may well be drawn around the stem. The

length of the zones may usually be five millimeters. If the growing region is believed to be short, the zones should be of only 2 millimeters, but vigorous vines may be ruled in centimeter zones. After making the marks measure the zones again to be sure that the marking has been accurate. At the end of twenty-four hours, measure the length of each zone and tabulate the increase by zones. From these results plot five curves showing results with individual plants. This experiment is to be made with each of the plants used in the following three experiments. The region marked off into zones must in every case be long enough so that a number of consecutive zones farthest from the tip show no growth.

2. Make a daily record, extending over twenty-eight days, of the growth of the main axis of the shoot of five erect dicotyledonous herbs, and five woody dicots. Continue the experiment for five months longer making weekly determinations of growth. The determinations should be made by direct measurement, from a fixed and unmistakable point which is certainly below the entire growing zone, to the tip as fixed in the preceding experiment. In order to avoid measuring too long a stretch of stem, it will be necessary from time to time to take a new point from which to measure.

3. This experiment is like the preceding except that as subjects ten shoots of monocotyledonous plants are to be chosen. Of these, one should be sugar cane, one should be maize, one should be a Dioscorea, one should be an erect bamboo, and one a climbing bamboo. In the case of plants with a short growing season, the observations should begin with the appearance of the plant above the ground and the experiment may terminate with the definite cessation of growth. In this experiment, the intercalary growth of the subjects makes care necessary in being sure that measurements cover the entire growing region.

4. This experiment differs from F-2 only in that the subjects are ten species of dicotyledonous vines. These should include vines which climb by twining, by tendrils, and by metamorphosed roots. with regard to subjects of short life, observe the same rules as in the preceding experiment.

5. Use as subjects a dicot seedling and a monocot seedling. Use five plants of each, and place these where they will receive varying degrees of illumination. Record the growth of stem and leaf if practicable daily for one week and weekly for at least three weeks more.

6. Germinate in complete darkness maize, some kind of bean, and some kind of tuber. Keep a daily record of the growth of stem and leaves until growth ceases.

7. Giving the plants full illumination, grow side by side in the open air three seedlings of the same kind. Keep the soil of the one saturated; give one as little water as will permit the plant to remain fresh; and keep the soil of the third moderately moist. Record the growth weekly for one month; if the results are not yet conclusive, continue the experiment until they are.

8. Using subjects as in the preceding experiment, keep one plant in a saturated atmosphere and the other in reasonably dry air. Make observations as in F-7.

9. Using a number of individuals of the same kind and of known and uniformly rapid growth, secure the data during ten hours and plot the curve of growth, at temperatures from zero to 45 degrees, at 5 degrees intervals.

10. Determine the rate of growth in open ground on the farm, in brush on the farm, in shade on the farm, at the first creek, at the first forest camp, at an altitude of 600 meters, at a point 100 meters below

the summit of Maquiling, in open ground on the summit, and in shade on the summit. Mark ten plants in each place and make measurements weekly for three successive weeks. Check your observations with the records on temperature and other climatic factors, and interpret your results. This experiment should not be undertaken until you have obtained skill and accuracy in such work.

11. By direct measurement, determine the growth by day and by night, using exactly twelve hour intervals, of the stem of bamboo and the youngest leaf of a young coconut tree.

12. Plant seeds of ten kinds on the surface of the ground and keep them moist enough to permit germination. Measure the growth daily until the seedling reaches a height of 20 cm. or until the third leaf after the cotyledons has expanded.

13. By means of the auxanometer, record the growth of the stem of a leguminous plant during three days. Compare the results with those obtained in experiment F-11, and with the thermograph record during the same period.

14. By means of the horizontal microscope, measure the growth of the plant used in experiment F-13 at five minute intervals for one hour.

15. On young trees of two kinds, determine the rate of growth, at weekly intervals for six weeks, of the main axis, of three primary branches, and of three secondary branches.

16-A. Beginning with the first recognizable appearance of the leaf, measure the length and width of a simple dicot. leaf at daily intervals until growth ceases.

16-B. Beginning with its youngest recognizable appearance in the bud, measure the growth in length and width of a leaf of Dioscorea marking the young leaf into transverse zones of 1 mm. and recording the growth by zones and as a whole.

16-C. Make as complete observations as possible of the growth of the leaves of a climbing bamboo.

17. Use as subjects some species of Ficus and some climbing Aroid, both of which normally produce long aerial roots. Mark the root in zones of 1 mm. and measure the growth after one day and for seven days.

18. Mark the primary root of a legume into millimeter zones and measure its growth by zones after one day and plot this curve of growth by zones. It will be convenient in this experiment to have the root grow inside a glass tube.

19. Expose some active roots of three kinds of plants of considerable size. Clean one root of each without injuring it, dry it, mark it into zones, inclose it with a glass tube, cover the tube with a leaf and cover the whole with soil. Record the growth by zones after one day, and the total growth daily for one week.

G.

1. Mark into zones, as in Experiment F-1, one stem each of a dicot. vine, an erec- dicot. herb, and a monocot. Place these marked stems with their long axes horit zontal. Record, by tracing, the resulting curvatures, and explain the relation between these curves and the zones of most active growth. Continue the observation until all curving ceases.

2. Mark zones on actively growing roots of three kinds of seedlings. Fasten with the long axes horizontal. Observe and record as in the preceding experiment.

3. Use six seedlings, with the main root and shoot each a few centimeters long. Mark stem and root to show growth by zones. Place three seedlings on a centri-

fuge with the long axes tangential in the plant of rotation. Rotate one seedling for 5 minutes, one for 10 minutes, and one for 15 minutes. Place the thoer three with their long axes horizontal, leaving one for 5 minutes, one for 30 minutes and one for an hour. Place all seedlings on the clinostat at the end of the stated periods of exposure. Care must be taken that the seedlings are in all cases kept moist. Record all resulting curvatures.

4. Use the same materials as in Experiment G-1, and mark in the same manner. Place the subjects of experiment, with their long axes erect, in a place where all light comes from one side. Observe and report as in G-1.

5. Use a wooden box blackened on the inside, but leaving on one side a round hole 5 centimeters in diameter. Cover this from the inside with a glass plate, marked in circles like a target, the rings being 1 centimeter apart and having their center cover the middle of the hole. Twenty centimeters back of the hole, and 5 centimeters below it, place a piece of horse manure covered with Pilobolus in fruit. After there has been a vigorous discharge of the spore masses of the fungus, open the box and make a complete record of the location of these discharged masses.

6. Use healthy pot plants of Coleus and Calathea; expose to illumination from one side, and record all changes in the position of all leaves. Besides the subjects of experiment, keep control plants on the clinostat with erect axes. Note behavior by night as well as by day, for one week.

7. On the surface of a ball of Spagnum or macerated fibrous material which can easily be kept damp, germinate seed of rice, and of radish. As the roots grow down around the ball, observe their tendency to remain in contact, rather than to leave it and grow directly downward.

8. Grow seedlings of radish in soil in a box, which has one side of glass, sloping inward toward the bottom. Place in this box and against the glass a porous cup containing water. Supply no water except through this cup. Germinate the seedlings at various distances and observe the direction which the roots take with reference to the cup.

H.

1. Place a paper bag around an ear of maize before the silk is exposed, and keep sacked for one month. Treat another ear in the same way except for putting 10 grains of pollen on the silk at its maturity. Treat a third ear in the same way, but dust cupiously with fresh pollen while the silk is mature. When grain should be mature, examine the ears and report.

2. Sack two ears of maize as in the preceding experiment. When the silk is mature, dust one thoroughly with pollen from the same plant, and another with pollen from a different plant. Determine the weight of grains and the germinating capacity of the crop on these ears.

3. Find a papaya plant of a strain which is normally monoecious, but which bears some perfect flowers. Pollinate these perfect flowers. When mature, collect the seed, plant it, and observe the sex of the plants grown from this seed. Get pollen from this plant and apply it to a strictly pistillate plant, taking care to exclude other pollen from the flowers treated. Collect the seed produced by the flower so treated, plant the seed, and observe the sex of the resulting crop.

CURRENT LITERATURE

There is a story of a Secretary of Public Instruction in the early days of this government who gave his chief of the Bureau of Education a free-hand in the establishment of an educational system with a single proviso that he did not want "any..... botany nor any..... music." He would probably have been surprised to learn that the most powerful agency in the development and diversification of the agriculture of the whole Malay region had been a botanic garden. It must be supposed that he would likewise be surprised at the material just published as "Miscellaneous Botanical Notes" in the Agricultural Bulletin of the Federated Malay States. These notes cover the following subjects:

Cost of Treatment of Pink Disease (Corticium salmonicolor) of para rubber.

Distribution of the Brown Root Fungus, Hymenochaete noxia, also a pest of para rubber.

The spread of Fomes semitostus by wash. This fungus causes still another rubber disease.

The Disease of Hevea caused by Phyllosticta ramicola.

Disease of Angsana. This reports the appearance of Polystictus hirsutus as a parasite.

Bonduc Seeds or Knicker Seeds. This note reports a case exhibiting symptoms similar to those associated with cholera, and suspected of being produced by overdosing with the seed of Caesalpinia Bonduc.

The same journal (Journal d'Agriculture Tropicale), No. 137, contains interesting information on the use of machinery in rice culture in Indo-China, and the fiber industry of the French Soudan. The first paper reports work done under the auspices of the Association Rizicole Indochinoise. This work was begun in 1905, abandoned for a time, and taken up again in 1901. The published account reads very naturally to those who have worked under similar conditions. The land chosen turned out to be too low to give the best prospect of success; the machines persisted in developing defects; Saigon turned not to be Paris, so much time was lost in making repairs; the rains came at their own pleasure; the laborers left in a body when the crop was near maturity; the birds did the harvesting; and the engineer in charge returned to France without heart or taste for renewed experiments. In spite of all this, the author of the published report, Mr. Main, draws encouragement from the results and is right in so doing. It was demonstrated, to the satisfaction apparently of the Annamite natives, that rice paddy could be cultivated with traction plows. It was found that the dense growth of reeds covering the lowlands adapted to rice culture could be promptly gotten rid off by mowing them below the surface of the water by machinery. And plots sown with a drill aroused the interest of the neighbors by their excellent showing in comparison with adjacent transplanted plots. This is certainly a good showing in results for work extending over but little more than a single year.

The record for barbarous harvesting is not held by the people of the southern Philippines, and the islands to the southwest, who have always collected gutta percha by cutting the tree down and then tapping it, but rather by the Soudanese natives who harvest kapok by felling the trees. Kapok is too easily gathered in other ways to give even an excuse for such methods, and these have now been forbidden by the French government.

Two companies are reported as having established Sisal plantations in Soudan, one of 400 and one of 100 hektares. Experiments on plants grown from suckers,

and those grown from bulbils gave a yield from the former of 3.51%, and from the latter of 3% of the weight of the leaves. The plants from bulbils were too young to give a proper return. One hundred leaves from plants which had yielded an harvest the preceding year yielded 2.023 kilos of fiber or 4.153% of the green weight; while plants harvested for the first time yielded 2.205 kilos or 3.445% of the fresh weight. Some experiments have been made in the same region with Hibiscus cannabinus locally known as "Dhâ". In the opinion of the writer of the report, this plant offers no better promise than other known Malvaceae as a possible substitute for jute.

A statement of the condition of the American Beet-Sugar Industry in 1910 and 1911, and of the work done by the United States Bureau of Agriculture on this crop, has just been published as bulletin No. 260 of the Bureau of Plant Industry. Although the sugar beet is a plant of temperate zones, the advance of the beet industry is a matter of greatest interest in the Philippines because of its relation to our own trade in cane sugar. The development of the industry in the United States is illustrated by the following table:

Year	Sugar manufactured. Short tons.
1901-2	184,605
1902-3	218,406
1903-4	240,604
1904-5	242,114
1905-6	312,920
1906-7	483,611
1907-8	463,628
1908-9	425,884
1909-10	512,469
1910-11	510,172
1911-12	599,500

The study of the subject reported in this bulletin is not merely experimental, but includes an economic study of the business in both Europe and America. The general advance in intensive agriculture in Europe during the last few decades has been intimately associated with the extension of the beet industry. Its value in other respects is so great that it is stated that "Beet culture * * * has become such an indispensable part of European agriculture that it would be continued in consideration of the indirect returns even if there were no direct profits from the sale of the beets." There are tabulated the observations of 115 American farmers who have kept records of their crop yields before and after beet culture. This table, which follows, shows increases which are remarkable indeed in the yields of other crops grown in rotation with sugar beet:

Crops	Average yield per acre.			
	Before beets	After beets	Increase	
			Actual	Percent
Wheat...bushel....	28.88	43.07	14.19	49.1
Corn.... do.....	41.6	53.1	11.5	27.6
Oats.... do.....	40.9	60.6	19.7	48.1
Barley... do.....	38.97	59.14	20.17	52.0

Crops	Average yield per acre.			
	Before beets	After beets	Increase	
			Actual	Percent
Rye.....	.....	.....	.....	39.0
Potatoes, bushel..	151.97	222.2	70.25	46.2
Hay, tons.....	5.7	7.7	2.0	35.0
Beans, bushel.....	15.66	20.26	4.6	29.5

A notable part of the bulletin is the section entitled "Lost motion in the sugar beet industry" which is an attempt to apply to the beet industry the principles now commonly recognized in the United States as "Scientific Management."